

or

the determination using the default protocol yields "fully supporting but threatened" and the threat will yield a determination of other than fully supporting within two years of the determination.

Fish & Wildlife Propagation (F&WP)

The methodology for the Fish & Wildlife Propagation (F&WP) beneficial use consists of eight types of data, each with its own attainment methodology.

The F&WP beneficial use is considered *attained* if:

in the absence of biological data, all six chemical methodologies (DO, Toxicants, pH, Turbidity, Oil & Grease, and Toxicants Not Assessed & Not Likely to Occur or Violate Criteria) result in a determination of attained

or

in the absence of adequate data for all six chemical data types, the biological data methodology results in a determination of attained.

The F&WP beneficial use is considered *not attained* if **any** of the eight data type methodologies result in a determination of *not attained*.

Dissolved Oxygen (DO)

Streams

A minimum of ten (10) samples is required to make an attainment determination.

The F&WP beneficial use is considered *attained with respect to dissolved oxygen* if 10% or fewer of the samples from a waterbody have a DO concentration of less than:

- 3.0 mg/L (4.0 mg/L from April 1 – June 15) for habitat limited aquatic communities (HLAC)
- 5.0 mg/L (4.0 mg/L from June 16 – October 15) for warm water aquatic communities (WWAC)
- 6.0 mg/L (5.0 mg/L from June 1 – October 15) for trout fisheries and cool water aquatic communities (CWAC)

The F&WP beneficial use is considered *not attained with respect to dissolved oxygen* if more than 10% of the samples from a waterbody have DO concentrations less than those shown above or if more than 2 samples in a given year are below 2 mg/L.

Lakes

For lakes or arms of 250 acres or less, a minimum of ten (10) samples is required to make an attainment determination. For lakes or arms of greater than 250 acres, a minimum of twenty (20) samples is required.

The F&WP beneficial use is considered *attained with respect to dissolved oxygen* if:

more than 50% of the lake water column has a DO concentration of 2.0 mg/L or more

and

90% or more of the surface samples have a DO concentration of 5 mg/L (4.0 mg/L from June 16 – October 15) or more.

The F&WP beneficial use is considered *not attained with respect to dissolved oxygen* if:

50% or more of the lake water column has a DO concentration of less than 2.0 mg/L

or

10% or more of the surface samples have a DO concentration of less than 5 mg/L (4.0 mg/L from June 16 – October 15).

Toxicants

A minimum of five (5) samples is required to make an attainment determination.

The following screening values shall be used to make attainment decisions for toxicants:

- the acute and/or chronic criteria for a given toxicant, as described in Appendix G, Table 2 of the Oklahoma Water Quality Standards, OAC 785:45
- the chronic ammonia toxicity value shown in Table 13 corresponding to the stream pH and temperature at the time of sampling

For metals, preference shall be given to attainment decisions based on dissolved metals in accordance with the procedures specified in OAC 785:46-15-5(h).

ACUTE EFFECTS

The F&WP beneficial use is considered *attained with respect to an individual toxicant* if no more than one (1) of the samples have concentrations of a toxicant that exceed the acute criterion or screening value for that toxicant.

The F&WP beneficial use is considered *not attained with respect to an individual toxicant* if more than one (1) of the samples have concentrations of a toxicant that exceed the acute criterion or screening value for that toxicant.

CHRONIC EFFECTS

The F&WP beneficial use is considered *attained with respect to an individual toxicant* if:

not more than one (1) of the samples have concentrations of a toxicant that exceed the chronic criterion or screening value for that toxicant

or

not more than 10% of the samples have concentrations of a toxicant that exceed the chronic criterion or screening value for that toxicant

The F&WP beneficial use is considered *not attained with respect to an individual toxicant* if more than 10% of the samples have concentrations of a toxicant that exceed the chronic criterion or screening value.

TABLE 13. TEMPERATURE- AND PH-DEPENDENT SCREENING VALUES FOR AMMONIA

pH	Temperature (°C)									
	0	14	16	18	20	22	24	26	28	30
6.5	6.67	6.67	6.06	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	6.57	6.57	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	5.86	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	6.29	6.29	5.72	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	6.12	6.12	5.56	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	5.91	5.91	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18

7.1	5.67	5.67	5.15	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	5.39	5.39	4.90	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.30	3.78	3.32	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.61	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	3.58	3.58	3.25	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	3.18	3.18	2.89	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.80	2.80	2.54	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	2.43	2.43	2.21	1.94	1.71	1.50	1.32	1.16	1.02	0.897
8.1	2.10	2.10	1.91	1.68	1.47	1.29	1.14	1.00	0.879	0.773
8.2	1.79	1.79	1.63	1.43	1.26	1.11	0.973	0.855	0.752	0.661
8.3	1.52	1.52	1.39	1.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	1.29	1.29	1.17	1.03	0.906	0.796	0.700	0.615	0.541	0.475
8.5	1.09	1.09	0.990	0.870	0.765	0.672	0.591	0.520	0.457	0.401
8.6	0.920	0.920	0.836	0.735	0.646	0.568	0.499	0.439	0.386	0.339
8.7	0.778	0.778	0.707	0.622	0.547	0.480	0.422	0.371	0.326	0.287
8.8	0.661	0.661	0.601	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.565	0.565	0.513	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9.0	0.486	0.486	0.442	0.389	0.342	0.300	0.264	0.232	0.204	0.179

pH

A minimum of ten (10) samples is required to make an attainment determination.

The F&WP beneficial use is considered *attained with respect to pH* if 10% or fewer of the samples fall outside the screening range of 6.5 (minimum) and 9.0 (maximum).

The F&WP beneficial use is considered *not attained with respect to pH* if more than 10% of the samples fall outside the screening range of 6.5 (minimum) and 9.0 (maximum).

Biological Data

Biological criteria have been established for various ecoregions in Oklahoma under OAC 785:46-15-5. See Figure 3. These biocriteria should be referenced when making attainment determinations. OAC 785:46 Appendix C Index of Biological Integrity should be used for these ecoregions. This methodology is only applicable to wadable streams.

For waterbodies where no biological data is available, a resulting determination of "attained" with respect to all six chemical data type methodologies (DO, pH, Toxicants, Turbidity, Oil & Grease, and Toxicants Not Assessed & Not Likely to Occur or Violate Criteria) may serve to determine attainment of the F&WP beneficial use.

For waterbodies where *only* biological data is available, a determination of "attained" with respect to biological criteria may serve to determine attainment of the F&WP beneficial use.

The F&WP beneficial use is considered *attained with respect to biological criteria* if:

for streams in ecoregions where biological thresholds have been determined, a biological assessment yields an Index of Biotic Integrity (IBI) associated with "fully supported."

or

for streams outside of ecoregions where biological thresholds have been determined, fish and benthic invertebrate communities are at least 70% similar to communities found in regional reference conditions considering the beneficial use sub-category appropriate for the stream in question.

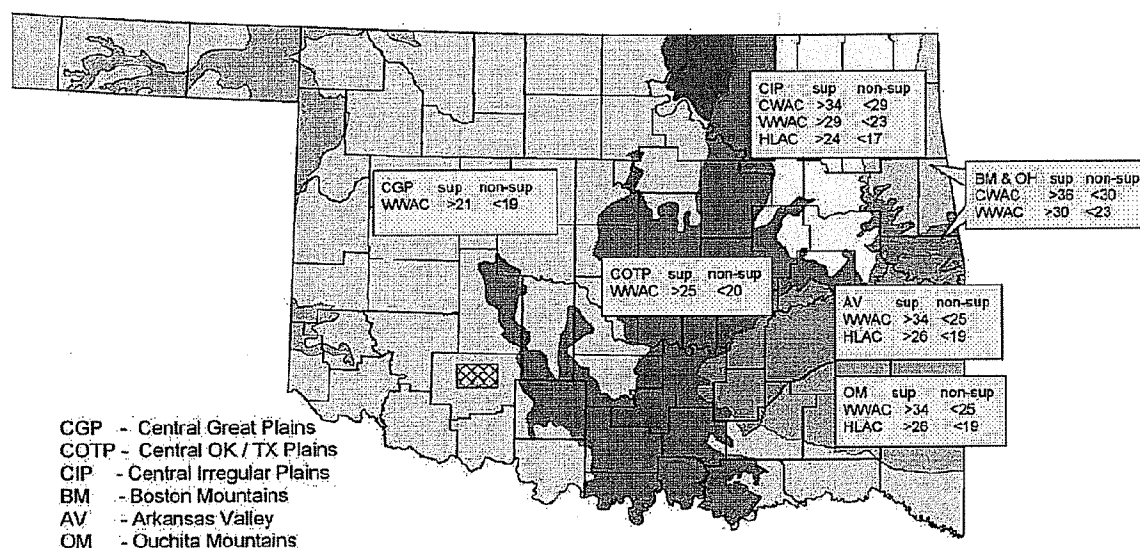
The F&WP beneficial use is considered *not attained* with respect to biological criteria if:

for streams in ecoregions where biological thresholds have been determined, a biological assessment yields an Index of Biotic Integrity (IBI) associated with "partially supported" or "not supported."

or

for streams outside of ecoregions where biological thresholds have been determined, fish and benthic invertebrate communities are less than 40% similar to communities found in regional reference conditions considering the beneficial use sub-category appropriate for the stream in question.

FIGURE 4. ECOREGIONS WHERE BIOCRITERIA HAVE BEEN ESTABLISHED



Turbidity

A minimum of ten (10) samples collected under seasonal base flow conditions is required to make an attainment determination.

The following numerical criteria shall be used to make attainment decisions for turbidity:

- 10 Nephelometric Turbidity Units (NTUs) for cool water aquatic communities and trout fisheries
- 25 NTUs for lakes
- 50 NTUs for other surface waters

The F&WP beneficial use is considered *attained* with respect to turbidity if:

10% or fewer of the samples exceed the appropriate screening level or water quality criterion.

or

the numerical criteria yield a determination of "fully supporting but threatened" and the threat will not yield a determination of other than fully supporting within two years of the determination.

The F&WP beneficial use is considered *not attained with respect to turbidity* if:

Greater than 10% of the samples exceed the appropriate screening level or water quality criterion

or

the numerical criteria yield a determination of "fully supporting but threatened" and the threat will yield a determination of other than fully supporting within two years of the determination.

Oil & Grease

A minimum of ten (10) visual observations made over a period of at least ten (10) months is required to make an attainment determination.

Any of the following visual characteristics shall indicate the presence of oil or grease:

- a rainbow sheen that flows when stirred, rather than cracking
- a golden tan to dark brown coating or globules on the water or in stream sediment

The F&WP beneficial use is considered *attained with respect to oil & grease* if 10% or fewer observations reveal the presence of oil or grease.

The F&WP beneficial use is considered *not attained with respect to oil & grease* if more than 10% of the observations reveal the presence of oil or grease.

Sediment

The F&WP beneficial use is considered *attained with respect to sediment* if the use is also attained with respect to biological criteria.

If the biological data assessment results in a determination of "not attained," a habitat assessment must be conducted using the habitat assessment protocols found in OWRB Technical Report TRWQ2001-1, "Unified Protocols for Beneficial Use Assignment for Oklahoma Wadable Streams."

The results of the habitat assessment shall then be compared to either historical conditions or regional reference conditions in order to determine attainment with respect to sediment. The method for establishing reference conditions shall meet the following requirements:

- a minimum of five (5) reference streams or reaches shall be assessed
- the reference streams or reaches must be within the same ecoregion as the test stream
- the reference streams or reaches must be within streams with similar flow regimes no more than two (2) stream orders(as defined in 46:1-2) removed from the test stream
- the reference streams or reaches shall be selected from the least impacted streams within the ecoregion whose watersheds contain soils, vegetation, land uses, and topography typical of the watershed of the test stream.

The F&WP beneficial use is considered *not attained with respect to sediment* if any of the following habitat parameters deviate from the reference conditions by the specified amount:

Pool Bottom Substrate – the total percent of clay, silt, and loose sand in the test stream is increased by more than 30% over the reference condition

Cobble Embeddedness – cobble embeddedness is increased by 15% or more over the reference condition

Point Bars and/or Islands – reach length percentage containing fresh (non-vegetated) point bars and/or islands is 20 or more percentage points above that of the reference condition

Deep Pools – percentage of reach dominated by deep (0.5 meters or more) pools is less than 70% of that of the reference condition

If all of the habitat parameters identified above deviate from the reference conditions by less than the amounts specified, then the Fish and Wildlife Propagation beneficial use is not impaired due to suspended and bedded sediments.

Toxicants Not Assessed and Not Likely to Occur or Violate Criteria

The data required to assess every water quality criterion – specifically toxicants – associated with the F&WP use do not always exist for a particular waterbody. The following procedure may be used to determine attainment of the F&WP beneficial use with respect to toxicants that have not been assessed, but are not likely to occur or violate criteria.

The following three types of information must be available in order to apply this procedure:

1. The results of a review of watershed-specific landuse and historical data that yields patterns of use or nonuse of the toxicant(s) not assessed.
2. A result of either "attained" or "not enough information" for the Toxicants methodology.
3. A result of either "attained" or "not enough information" for the Biological Data methodology.

NOTE: The decision matrix below may be used to determine attainment of the F&WP beneficial use with respect to the unassessed toxicants *only if* the landuse and historical data review yields no indication that the unassessed toxicants are present or likely to impact the waterbody in question.

TABLE 14. DECISION MATRIX FOR TOXICANTS NOT ASSESSED OR LIKELY TO OCCUR OR VIOLATE F&WP CRITERIA

		Biological Data	
		Attained	Not Enough Information
Toxicants	Attained	F&WP <i>Attained</i> With Respect To Unassessed Toxicants	F&WP <i>Attained</i> With Respect To Unassessed Toxicants
	Not Enough Information	F&WP <i>Attained</i> With Respect To Unassessed Toxicants	<i>Not Enough Information</i> to Determine F&WP Attainment With Respect to Unassessed Toxicants

Primary Body Contact Recreation (PBCR)

A minimum of ten (10) samples is required to make an attainment determination. Samples must be taken during the recreation period of May 1 – September 30.

Geometric means will be calculated using all data meeting the temporal data requirements. The geometric means will be compared to the appropriate screening value.

Fecal Coliform

The PBCR beneficial use is considered *attained with respect to fecal coliform* if:

the geometric mean of the samples does not exceed 400 colonies/100 mL

and

25% or fewer of the individual samples exceed 400 colonies/100 mL

The PBCR beneficial use is considered *not attained with respect to fecal coliform* if:

the geometric mean of the samples exceeds 400 colonies/100 mL

or

more than 25% of the individual samples exceed 400 colonies/100 mL

Escherichia coli (E. coli)

The PBCR beneficial use is considered *attained with respect to E. coli* if:

the geometric mean of the samples does not exceed 126 colonies/100 mL

or

no sample exceeds 406 colonies/100 mL (235 colonies/100 mL for Scenic Rivers and lakes)

The PBCR beneficial use is considered *not attained with respect to E. coli* if:

the geometric mean of the samples exceeds 126 colonies/100 mL

and

any sample exceeds 406 colonies/100 mL (235 colonies/100 mL for Scenic Rivers and lakes)

Enterococci

The PBCR beneficial use is considered *attained with respect to Enterococci* if:

the geometric mean of the samples does not exceed 33 colonies/100 mL

or

no sample exceeds 406 colonies/100 mL (61 colonies/100 mL for Scenic Rivers and lakes)

The PBCR beneficial use is considered *not attained with respect to Enterococci* if:

the geometric mean of the samples exceeds 33 colonies/100 mL

and

any sample exceeds 406 colonies/100 mL (61 colonies/100 mL for Scenic Rivers and lakes)

Secondary Body Contact

Attainment for the SBCR beneficial use is identical to the PBCR attainment methodology, but using five times (5x) the PBCR numerical criteria and screening levels.

Public and Private Water Supply (PPWS)

In order to determine attainment of the PPWS beneficial use, samples must be taken at the point of a drinking water intake.

Toxicants

A minimum of ten (10) samples is required to make an attainment determination.

The PPWS beneficial use is considered *attained with respect to any individual toxicant* for which there is a water quality criterion established if:

10% or fewer of the samples have concentrations of a toxicant that exceed the criterion for that toxicant

and

no drinking water use restrictions related to source water contamination are in effect

The PPWS beneficial use is considered *not attained with respect to any individual toxicant* for which there is a water quality criterion established if:

more than 10% of the samples have concentrations of a toxicant that exceed the criterion for that toxicant

or

a drinking water use restriction related to source water contamination is in effect

Total Coliform

A minimum of ten (10) samples is required to make an attainment determination.

The following numerical criterion shall be used to make attainment decisions for bacteria:

- 5000 colonies/100 mL

The PPWS beneficial use is considered *attained with respect to bacteria* if:

the numerical criterion yields a determination of "fully supporting" using the default protocol

or

the numerical criterion yields a determination of "fully supporting but threatened" using the default protocol if the threat will not yield a determination of other than fully supporting within two years of the determination

or

the Primary Body Contact Recreation use is attained.

The PPWS beneficial use is considered *not attained with respect to bacteria* if:

the numerical criterion yields a determination of "not supporting" using the default protocol

or

the numerical criterion yields a determination of "fully supporting but threatened" using the default protocol *if* the threat will yield a determination of other than fully supporting within two years of the determination.

Oil & Grease

A minimum of ten (10) visual observations made over a period of at least ten (10) months is required to make an attainment determination.

Any of the following visual characteristics shall indicate the presence of oil or grease:

- a rainbow sheen that flows when stirred, rather than crackling
- a golden tan to dark brown coating or globules on the water or in stream sediment

The PPWS beneficial use is considered *attained with respect to oil & grease* if 10% or fewer observations reveal the presence of oil or grease.

The PPWS beneficial use is considered *not attained with respect to oil & grease* if more than 10% of the observations reveal the presence of oil or grease.

Parameters Not Assessed and Not Likely to Occur or Violate Criteria

The data required to assess every water quality criterion associated with PPWS does not always exist for a particular waterbody. In those cases, the following procedure should be followed in order to make an attainment decision.

For parameters not assessed or which are not likely to occur or violate criteria, attainment decisions should be made based on two kinds of information:

1. the results of analysis of chemical-specific parameters routinely monitored by the State's Beneficial Use Monitoring Program (BUMP) as compared to state criteria associated with PPWS
2. the results of a review of watershed-specific landuse and historical data that yields patterns of use for the pollutant in question

The PPWS beneficial use is considered *attained with respect to unassessed parameters* if:

the waterbody is attaining the PPWS use for BUMP parameters according to the Toxicants section of this listing methodology

and

no suspicion of the presence of the unassessed parameters exists based on landuse and historical data review

Chlorophyll-a and Phosphorus

Certain water supplies have specific criteria for chlorophyll-a and/or total phosphorus as specified in OAC 785:45-5-10(7) and (8). Attainment of these criteria will be evaluated using the specified criteria and the long-term average default protocol.

Emergency Water Supply (EWS)

All waterbodies designated with the Emergency Water Supply beneficial use shall be deemed to be attaining the beneficial use for all water quality related issues.

Agriculture**Total dissolved solids (TDS)**

A minimum of ten (10) samples is required to make an attainment determination.

The Agriculture beneficial use is considered *attained with respect to TDS* if:

no TDS sample exceeds 700 mg/l

or

the mean of all TDS samples does not exceed the yearly mean standard (YMS) for TDS as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria

and

10% or fewer TDS samples exceed the sample standard (SS) for TDS as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria.

The Agriculture beneficial use is considered *not attained with respect to TDS* if:

At least one TDS sample exceeds 700 mg/l

and

more than 10% of the samples exceed the sample standard (SS) for TDS as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria

or

the mean of all samples exceeds the yearly mean standard (YMS) for TDS as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria.

Chlorides

A minimum of ten (10) samples is required to make an attainment determination.

The Agriculture beneficial use is considered *attained with respect to chlorides* if:

no chloride sample exceeds 250 mg/l

or

the mean of all samples does not exceed the yearly mean standard (YMS) for chlorides as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria

and

10% or fewer samples exceed the sample standard (SS) for chlorides as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria.

The Agriculture beneficial use is considered *not attained with respect to chlorides* if:

At least one chloride sample exceeds 250 mg/l

and

more than 10% of the samples exceed the sample standard (SS) for chlorides as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria

or

the mean of all samples exceeds the yearly mean standard (YMS) for chlorides as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria.

Sulfates

A minimum of ten (10) samples is required to make an attainment determination.

The Agriculture beneficial use is considered *attained with respect to sulfates* if:

no sulfate sample exceeds 250 mg/l

or

the mean of all samples does not exceed the yearly mean standard (YMS) for sulfates as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria

and

10% or fewer samples exceed the sample standard (SS) for sulfates as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria.

The Agriculture beneficial use is considered *not attained with respect to sulfates* if:

At least one sulfate sample exceeds 250 mg/l

and

more than 10% of the samples exceed the sample standard (SS) for sulfates as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria

or

the mean of all samples exceeds the yearly mean standard (YMS) for sulfates as listed in the Oklahoma Water Quality Standards (OAC 785:45 Appendix F) or site-specific/watershed-specific criteria.

Navigation

All waterbodies designated with the Navigation beneficial use shall be deemed to be attaining the beneficial use for all water quality related issues.

Aesthetics**Nutrients**

The Aesthetics beneficial use is considered *attained with respect to nutrients* if a nutrient impairment study yields a result of "fully supporting."

The Aesthetics beneficial use is considered *not attained with respect to nutrients* if a nutrient impairment study yields a result of "impaired."

Only a nutrient impairment study may be used to make a determination of *not attained* for aesthetics with respect to nutrients.

Wadable Streams

The aesthetics beneficial use for wadable streams is considered *attained with respect to nutrients* if application of the dichotomous process or application of the alternative to dichotomous process specified in OAC 785:46-15-10 yields a result of "not threatened."

Lakes and Nonwadable Streams

The aesthetics beneficial use for lakes and nonwadable streams is considered *attained with respect to nutrients* if planktonic chlorophyll-a values in the water column indicate a Carlson's Trophic State Index of less than 62.

Phosphorus

The phosphorus water quality standard applies to waters designated as a Scenic River.

A minimum of ten (10) samples is required to make an attainment determination. Samples must meet the data requirements of OAC 785:46-15-10(h)(2).

Attainment decisions will be made using the procedure specified in OAC 785:46-15-10(h).

Oil & Grease

A minimum of ten (10) visual observations made over a period of at least ten (10) months is required to make an attainment determination.

Any of the following visual characteristics shall indicate the presence of oil or grease:

- a rainbow sheen that flows when stirred, rather than crackling
- a golden tan to dark brown coating or globules on the water or in stream sediment

The aesthetics beneficial use is considered *attained with respect to oil & grease* if 10% or fewer observations reveal the presence of oil or grease.

The aesthetics beneficial use is considered *not attained with respect to oil & grease* if more than 10% of the observations reveal the presence of oil or grease.

Fish Consumption

The Fish Consumption beneficial use is considered *attained* if:

the numerical criteria for fish consumption in the Oklahoma Water Quality Standards [OAC 785:45-5-20(b)] yields a determination of "fully supporting" using the default protocol for long-term average numerical parameters

or

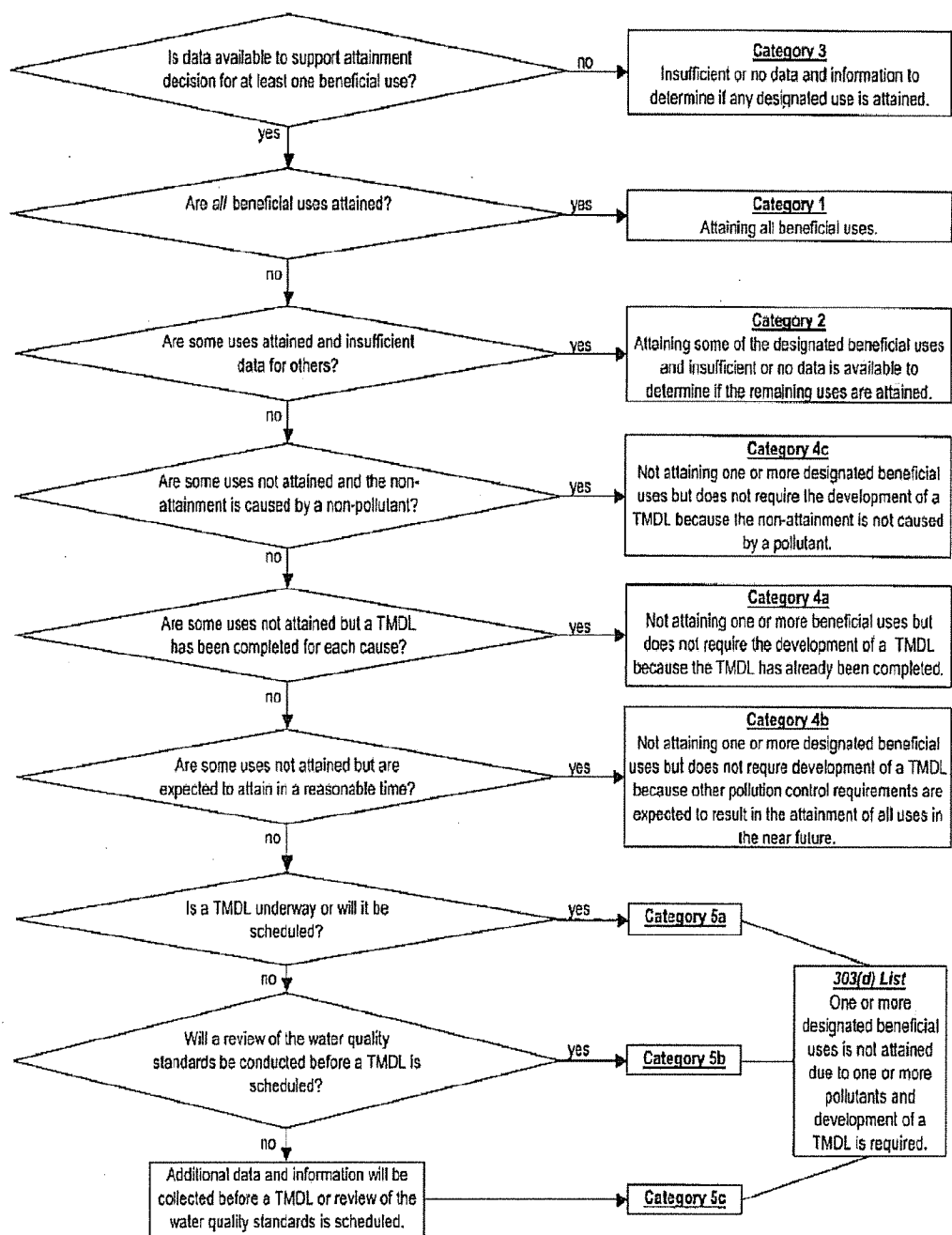
the numerical criteria for fish consumption in the Oklahoma Water Quality Standards [OAC 785:45-5-20(b)] yields a determination of "fully supporting but threatened" using the default protocol for long-term average numerical parameters if the threat will not yield a determination of other than fully supporting within two years of the determination.

The Fish Consumption beneficial use is considered *not attained* if any of the following conditions apply:

- The numerical criteria for fish consumption in the Oklahoma Water Quality Standards [OAC 785:45-5-20(B)] yields a determination of "not supporting" or "partially supporting" using the default protocol for long-term average numerical parameters.
- a site-specific consumption restriction is imposed
- a site-specific fish or shellfish ban is in effect for a sub-population thereof
- a site-specific aquatic life closure is in effect
- a site-specific "no consumption" advisory is in effect

Category Decision Methodology

The Integrated Water Quality Report contains five categories that describe different levels of beneficial use attainment in each of the State's waters. Each waterbody should be assessed for attainment of each of its individual designated beneficial uses using the methodology outlined above. Following that assessment, the decision tree in Figure 4 below should be used to assign each waterbody to an appropriate category.

FIGURE 5. INTEGRATED REPORT CATEGORY DECISION TREE

Causes of Non-Attainment

The previous methodology outlines the procedures for determining attainment of each designated beneficial use assigned to a waterbody. Causes of non-attainment must also be included in the State's Integrated Water Quality Assessment Report.

The causes and cause codes shown in Table 15 should be applied where applicable to each waterbody upon making a determination of non-attainment for any given designated beneficial use or subcategory of that use. Additional cause codes may be added to the State's Integrated Report in order to provide for numerical criteria in the State's Water Quality Standards not already represented with a cause code.

Sources of Non-Attainment

Sources are the activities, facilities, or conditions that contribute pollutants or stressors resulting in impairment of designated uses in a waterbody.

Determining the sources of designated use impairment can be a difficult process. Ambient monitoring data can give good evidence of the causes of impairment. In some cases, field observations can provide information on obvious, nearby problems; e.g., land use, substrate, and habitat may provide a basis for identifying sources. This is especially the case for "hydromodification" sources.

In most cases, additional information is needed – watershed land use inventories, records of permit compliance, locations of areas with highly erodible soils, areas with poor BMP (best management practice) implementation, measurements of in-place contaminants, or loadings from atmospheric transport or ground water.

For some waterbodies, potential non-point sources have been assigned to a cause using GIS data. Initially, an extensive list of potential sources for each cause is compiled. Geographical information such as the location of permitted activities (e.g., NPDES sources, CAFOs, oil & gas wells) and land use information (e.g., roads, pastures, cropland, municipal boundaries) is then compared to each watershed. Subsequently, potential sources not indicated by the geographic data are removed from the list of potential sources for a watershed. Potential sources not eliminated by the geographic information remain on the list as a potential source of impairment for waterbodies in the watershed.

This method of assigning potential sources has not been applied to all waterbodies and/or causes on the 2008 303(d) list. The intent is to use this methodology to assign potential sources to all 303(d) waterbodies for subsequent 303(d) lists.

A partial list of potential sources is shown in Table 16. Other source codes may be added as the need arises.

TABLE 15. CAUSE CODES

Cause	Cause Code
Ammonia (Unionized) - Toxin	91
Arsenic	96
Barium	104
Cadmium	127
Chloride	138
Chlorophyll- α	120
Chlorpyrifos	153
Chromium (total)	154
Color	160
Copper	163
DDT	214
Diazinon	187
Dieldrin	198
Enterococcus	215
Escherichia coli	217
Fishes Bioassessments (Streams)	230
Lead	267
Nitrates	302
Oil and Grease	317
Oxygen, Dissolved	322
Selenium	372
Sedimentation/Siltation	371
Silver	375
Sulfates	385
Total Coliform	398
Total Dissolved Solids	399
Toxaphene	496
Fecal Coliform	400
Turbidity	413
Zinc	423
pH	441
Phosphorus (Total)	462

TABLE 16. SOURCE CODES

Potential Source	Source Code
Acid Mine Drainage	2
Agriculture	156
Animal Feeding Operations (NPS)	4
Atmospheric Deposition – Acidity	8
CERCLA NPL (Superfund) Sites	16
Clean Sediments	21
Discharges from Biosolids (SLUDGE) Storage, Application or Disposal	33
Discharges from Municipal Separate Storm Sewer Systems (MS4)	34
Dredging (E.g. for Navigation Channels)	38
Grazing in Riparian or Shoreline Zones	46
Highway/Road/Bridge Runoff (Non-construction related)	49
Impacts from Land Application of Wastes	59
Impacts from Abandoned Mine Lands (Inactive)	56
Industrial Point Source Discharge	62
Land Application of Wastewater Biosolids (Non-agricultural)	68
Landfills	69
Leaking Underground Storage Tanks	70
Mine Tailings	82
Municipal (Urbanized High Density Area)	84
Municipal Point Source Discharges	85
Natural Sources	155
Non-irrigated Crop Production	87
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	92
Other Spill Related Impacts	97
Permitted Runoff from Confined Animal Feeding Operations (CAFOs) ¹	100
Petroleum/Natural Gas Production Activities (Legacy)	102
Rangeland Grazing	108
Releases from Waste Sites or Dumps	110
Residential Districts	111
Silviculture Harvesting	119
Spills from Trucks or Trains	124
Surface Mining	127
Source Unknown	140
Sources Outside State Jurisdiction or Borders	146
Total Retention Domestic Sewage Lagoons	128
Wastes from Pets	133
Wildlife Other than Waterfowl	136

TABLE 17. USEFUL INFORMATION IN DETERMINING SOURCES OF BENEFICIAL USE NON-ATTAINMENT

Source Category	Example Types of Information
<u>Industrial Point Sources</u>	<p>Permit compliance records</p> <ul style="list-style-type: none"> • analysis of DMRs • compliance monitoring or special monitoring in permits • WET or TIE bioassay tests <p>Monitoring/modeling studies</p> <ul style="list-style-type: none"> • upstream/downstream chemical, biological, and habitat monitoring • intensive surveys combined with WLA/TMDL modeling • complaint investigations • data from volunteer monitoring
<u>Municipal Point Sources</u>	<p>Permit compliance records</p> <ul style="list-style-type: none"> • analysis of routine DMRs • compliance monitoring or special monitoring in permits • WET or TIE toxicity bioassay tests <p>Monitoring/modeling studies</p> <ul style="list-style-type: none"> • upstream/downstream chemical, biological, and habitat monitoring • intensive surveys combined with WLA/TMDL modeling • complaint investigations • data from volunteer monitoring
<u>Combined Sewer Overflows (CSOs)</u>	<p>Permit compliance records</p> <ul style="list-style-type: none"> • records of nonachievement of targets for frequency of wet weather overflows • implementation of other minimum control and pollution prevention methods (as in EPA CSO Control Policy) <p>Monitoring/modeling studies</p> <ul style="list-style-type: none"> • upstream/downstream chemical, biological, or physical monitoring comparing wet weather and normal flow conditions • intensive surveys combined with WLA/TMDL modeling • complaint investigations
<u>Agricultural Point Sources (e.g., CAFOs)</u>	<p>Permit compliance records</p> <ul style="list-style-type: none"> • observation of overflows from total retention (non-discharge) facilities • compliance with provisions for off-site disposal of animal wastes (e.g., land application, composting) <p>Monitoring studies</p> <ul style="list-style-type: none"> • upstream/downstream chemical, biological, or physical monitoring (especially for nutrients and pathogens) • complaint investigations

Source Category	Example Types of Information
<u>Agriculture</u> (NPS)	<p>Information from monitoring and field observations (e.g., to document bad actors)</p> <ul style="list-style-type: none"> • edge of field monitoring of runoff from animal holding areas, cropped areas, or pastures • monitoring of inputs from irrigation return flows, sub-surface drains, or drainage ditches • proper installation of screens or other measures to avoid fish losses in drainage/irrigation ditches • serious rill or gully erosion in agricultural fields • sedimentation problems in agricultural watersheds • indications of unmanaged livestock in streamside management zones • complaint investigations or data from volunteer monitoring or inventories <p>Records on watershed BMP implementation status</p> <ul style="list-style-type: none"> • documented low implementation level (e.g., less than a 70% target) of recommended water quality BMPs • documented problems with specific agricultural operators <p>Modeling</p> <ul style="list-style-type: none"> • use of such models as AGNPS, SWAT or ANSWERS to estimate pollutant loads and improvement from BMP implementation • intensive surveys combined with WLA/TMDL modeling
<u>Silviculture</u> (NPS)	<p>Monitoring and field observations documenting instances of high sediment delivery to receiving waters</p> <ul style="list-style-type: none"> • BMPs not followed on logging road, skid paths, or stream crossings • BMPs not followed to protect streamside management zones • serious sedimentation problems (cobble embeddedness or interstitial D.O. problems) in watersheds that are largely silvicultural <p>Records on watershed BMP/management measure)</p> <ul style="list-style-type: none"> • implementation status • documented low implementation level of recommended water quality-oriented BMPs <p>Results of modeling or cumulative effects analyses</p> <ul style="list-style-type: none"> • use of such models as WRENS to estimate pollutant loads and likely improvement from BMP implementation • use of water temperature models to help quantify impacts on cold water fisheries • use of landscape analysis techniques (e.g., the RAPID method or Integrated Riparian Area Evaluation method) to document cumulative effects • intensive surveys combined with WLA/ TMDL modeling
<u>Construction</u>	<p>Information from monitoring and field observations (primarily to document problem areas or bad actors)</p> <ul style="list-style-type: none"> • sedimentation problems documented in watersheds with major construction activity • complaint investigations and volunteer monitoring data <p>Information from sediment control management agencies</p> <ul style="list-style-type: none"> • records of implementation of sediment control measures

Source Category	Example Types of Information
<u>Urban Runoff & Storm Sewers</u>	<p>Monitoring/modeling studies</p> <ul style="list-style-type: none"> • upstream/downstream chemical, biological, or habitat monitoring comparing wet weather and normal flow conditions near outfalls • special monitoring for BMP effectiveness-wet ponds, artificial wetlands, grass swales • intensive surveys combined with WLA/ TMDL modeling and catchment models such as SWMM • complaint investigations <p>Information from management agencies</p> <ul style="list-style-type: none"> • documented low implementation level of recommended/required water quality-oriented BMPs • documented problems with BMP operation and maintenance information from monitoring and field observations (primarily to document problem areas or bad actors)
<u>Resource Extraction (Petroleum)</u>	<p>Information from monitoring and field observations (primarily to document problem areas or bad actors)</p> <ul style="list-style-type: none"> • evidence of oil and brine spills affecting areas near receiving waters; elevated TDS, toxicity, oil and grease aesthetic impacts; increased erosion and sedimentation problems • complaint investigations and volunteer monitoring data <p>Information from petroleum management agencies monitoring data in streams, shallow wells, and springs in oilfield areas</p> <ul style="list-style-type: none"> • records of problems with spills, pipeline breaks, over-topping of pit berms, land application violations
<u>Resource Extraction (mainly surface mining)</u>	<p>Information from monitoring and field observations (primarily to document problem areas or bad actors)</p> <ul style="list-style-type: none"> • evidence of decreases in pH, toxicity from heavy metals, excessive sedimentation, or stream reaches with iron bacteria in watersheds with active mining • complaint investigations and volunteer monitoring data <p>Information from mining management agencies</p> <ul style="list-style-type: none"> • records of recurrent permit violations (e.g., over-berming of settling ponds, failure to contain leachates, or failure to revegetate or restore mined areas)
<u>Land Disposal</u>	<p>Monitoring and field observations (primarily to document problem areas or bad actors)</p> <ul style="list-style-type: none"> • monitoring indicates leachate migration from disposal area or industrial or domestic leach field failures • complaint investigations and volunteer monitoring <p>Modeling</p> <ul style="list-style-type: none"> • solute transport or plume models (e.g., PRIZM) indicate high potential for pollutants to reach receiving water

Source Category	Example Types of Information
<u>Hydromodification</u> <u>(dams, flow regulation)</u>	<p>Monitoring and field observations</p> <ul style="list-style-type: none"> recurring problems with inadequate instream flows (e.g., dewatering of streams, reduced pollutant assimilation, unnatural water temperatures) documented interference with fish migration and spawning movements (e.g., for such anadromous fish as salmon or rockfish but also for inland fish that seek spawning habitat outside lakes or large rivers) <p>Modeling</p> <ul style="list-style-type: none"> analysis using PHABSIM or other instream flow models to document adverse impacts analysis related to FERC permit renewal and State 401 Certification, habitat recovery plans under the ESA, or TMDL studies (e.g., problems with anoxic or nutrient-laden releases from hydrostructures)
<u>Hydromodification</u> <u>(channelization, dredging,</u> <u>removal of riparian</u> <u>vegetation, streambank</u> <u>modification,</u> <u>draining/filling of</u> <u>wetlands)</u>	<p>Monitoring (usually over considerable period of time) documenting adverse changes:</p> <ul style="list-style-type: none"> severe channel downcutting or widening elimination of vegetation in streamside management zones excessive streambank erosion and sloughing loss of significant wetland area in watershed failure of wetland mitigation projects <p>Modeling studies</p> <ul style="list-style-type: none"> decreases in pollutant assimilation from habitat modification adverse impacts on hydrology, water temperatures, or habitat
<u>Natural</u>	<p>Monitoring and field observations of the presence of sources that are clearly not anthropogenic</p> <ul style="list-style-type: none"> saline water due to natural mineral salt deposits low DO or pH caused by poor aeration and natural organic materials excessive siltation due to glacial deposits high temperatures due to low flow conditions or drought <p>Note: the Natural Sources category should be reserved for waterbodies impaired due to naturally occurring conditions</p>

Prioritization of TMDL Development & Future Monitoring

After the final determination of beneficial use attainment is made, a four-level priority ranking for TMDL development will be established including waters targeted for TMDL development within the next two years (Priority 1). In accordance with EPA guidelines, priority determinations will take into account the severity of the impairments and the designated uses of the waters impacted. Waters in Category 5 (the State's 303(d) list) will be aggregated and prioritized according to their eleven digit hydrologic unit code (HUC11) watershed. The prioritization process will closely follow that used to develop the Unified Watershed Assessment except where changes are necessary due to programmatic and logistical differences between the two programs. Primary and secondary criteria were developed to evaluate and prioritize watersheds for TMDL development. The primary evaluation criteria used were the vulnerability of waters to degradation, the risks to public health and the threat to aquatic life.

A watershed's vulnerability for degradation was evaluated by first calculating the percentage of impaired waters for each HUC11 watershed based on the stream miles or equivalent stream miles (for lakes) listed as impaired divided by the total equivalent stream miles within the watershed. A Pollutant Priority Score was also developed and used based on a pairwise comparison matrix rank of all pollutant(s) and then calculating the mean of the values for those pollutants causing impairments within each watershed. The presence of protected waters or EQIP local emphasis areas were also used to evaluate watershed vulnerability.

The threat to public health was also considered in the prioritization by evaluating both the population served by Public Water Supplies (PWS) and number of PWS intakes in the watershed. In both cases the more population served and the higher the number of intakes the more weight given to the risks to public health.

In assessing of the threats to aquatic life within a watershed consideration was given to the presence of threatened or endangered species along with the area of waters of recreational and/or ecological significance listed in Appendix B of the Oklahoma Water Quality Standards. Calculating the percent change in wetland area for each HUC11 watershed along with the presence of priority wetlands designated by the United States Fish and Wildlife Service were also used to evaluate the threats to aquatic life.

The outline below summarizes both the primary and secondary criteria used to establish the TMDL priority for each HUC11 watershed.

- 1) Vulnerability of waterbodies to degradation**
 - a) Percent Stream Length/Lake Area Impaired
 - b) Pollutant Priority Score (Pairwise pollutant comparison rating)
 - c) Pristine Waters
 - i) Scenic Rivers
 - ii) Outstanding Resource Waters
 - iii) High Quality Waters
 - iv) Sensitive Water Supplies
 - d) EQIP Local Emphasis Area
- 2) Risks to public health**
 - a) Public Water Supply Customers
 - b) Public Water Supply Intakes
- 3) Threat to aquatic life and other water-dependent wildlife**
 - a) Presence of threatened and endangered species.
 - b) Area of Waters of Recreational and/or Ecological Significance (Appendix B)
 - c) Wetland Area
 - i) Presence of USFWS Priority Wetlands
 - ii) Change in Wetland Area

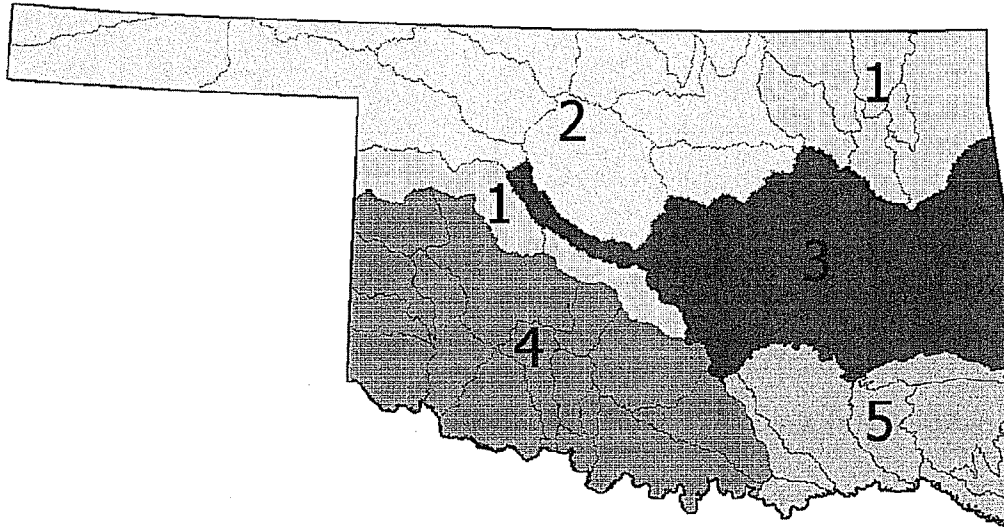
The priority ranking was established by giving each of the criteria above a ranking/points based on its overall importance. The criteria rankings or points were then totaled to give an overall score for each watershed. Table 16 below contains a more detailed summary of the actual weight given to each criterion.

2008 OK Integrated Report
Surface Water Assessment

TABLE 18. TMDL PRIORITIZATION-POINT RANKING

Points	Total Percent Impaired	Pollutant Priority Score	Wetland Percent Change	USFWS T&E Species	USFWS Wetland Priority	EQIP Local Emphasis Area	Highest Designated Protected Waterbody	Percent Appendix B Areas	PWS Intakes In HUC	PWS Customers Served
15	85	> 75th Quartile	>20%	≥ 3			Scenic R or ORW		≥ 4	≥ 100,000
10	65	Median to 75th Quartile	>10% to 20%	2			HQW		3	99,999 to 10,000
5	45	25th Quartile to Median	>5 to 10%	1	Yes	Yes	SWS	Upper 50th Percentile	2	9,999 to 1,000
3	25	< 25th Quartile	1 to 5%					Lower 50th Percentile	1	999 to 1
0	0	No Impairments	Gain or <1%		No	No		None	0	0

Where practicable, the State's Rotating Basin plan (Figure 5) will be used to schedule data collection projects in Category 2 & 3 waterbodies.

FIGURE 6. ROTATING BASIN PLAN WATERSHEDS BY YEAR**Coordination, Review, And Approval**

The DEQ has coordinated the development and submittal of the Integrated Water Quality Report. The process began with a notice and request for input sent to EPA Region 6, state environmental agencies, and Tribal environmental offices. A series of interagency meetings were conducted to review the listing methodology, review and discuss the draft list along with priority rankings and scheduling, and facilitate the exchange of information. The draft list will be circulated to EPA Region 6 and state environmental agencies for comment prior to release for public participation.

Public participation will be undertaken in two phases. When the process to identify candidate waters began, nominations from the public were solicited. This involved distribution of the mailout shown in Figure 7 in September, 2007. Once the final draft list is compiled, it shall be submitted for formal public review with notice and a 30-day comment period. Upon the close of the comment period, a responsiveness summary will be prepared. DEQ will coordinate public participation activities. After the public review period and finalization of the list, it will be formally submitted to EPA Region 6 for review and approval.

FIGURE 7. MAILOUT REQUEST FOR PUBLIC INPUT

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How to Provide Input

The Department of Environmental Quality invites you to provide water quality information to be considered in Oklahoma's Integrated Report. All information must be submitted either in writing or by E-mail before the end of the solicitation period. A summary of our decisions regarding the submitted information will be included in the final integrated report submitted to EPA Region 6.

Information should be directed to:
 Elena Jigoulina
 Water Quality Division
 Department of Environmental Quality
 P.O. Box 1677
 Oklahoma City, Oklahoma 73101

Information can also be submitted via E-mail to:
elena.jigoulina@deq.state.ok.us


In order to be considered, all nominations must be received before 5:00 P.M. on Friday, October 19th.

To Obtain More Information

Copies of the state's *Continuing Planning Process* and most recent 303(d) list (2004 Integrated Report, Category B), and 2006 draft report are available for downloading at:
<http://www.deq.state.ok.us/WQDnew/index.htm>


Copies of the *Use Support Assessment Protocols* and the most recent Oklahoma's *Water Quality Standards* are available for downloading at:
<http://www.oarib.state.ok.us/util/utilesrules.php>

DEPARTMENT OF ENVIRONMENTAL QUALITY
 P.O. BOX 1677
 OKLAHOMA CITY, OKLAHOMA 73101



Public Solicitation for
 Water Quality Information
 September 19th, 2007

• Sponsored By •



Water Quality Division
 P.O. BOX 1677
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Back

BACKGROUND

The State of Oklahoma is in the process of developing the 2008 Integrated Water Quality Monitoring and Assessment Report. The Integrated Report will include the 303(d) list. This list is used to establish priorities for water quality improvement measures, including development of total maximum daily loads (TMDLs) which are water quality planning documents that establish specific goals for water quality conditions.

This solicitation notice serves as a means of gaining information about water quality from the public. Once the final draft report is compiled, a formal public review and 30-day comment period, culminating with a formal public meeting, will complete the second phase of public participation.

According to section 303(d)(1) of the Clean Water Act, states are to identify waters that do not meet water quality standards, even after technology-based controls required by the Act, and any other controls required by state or local authority, are in place. These waters are called "water quality-limited" and may require the development of a TMDL in order to establish additional controls or management measures necessary to achieve water quality standards.

Federal regulations governing the 303(d) listing process and TMDL development are found at 40 CFR Part 130. The US Environmental Protection Agency (EPA) provided guidance to the states for developing Integrated Reports (USEPA, 2006). The EPA emphasized that the Integrated Report guidance does not alter the statutory provisions in sections 305b and 303d of the Federal Clean Water Act, nor does it change existing rules governing development of Impaired Waterbodies Lists discussed above.

Oklahoma's process for developing/revising its Integrated Report is contained in the State's

Continuing Planning Process ("CPP") document. (http://www.deq.state.ok.us/wqnew/pubs/2006_CPP_final.pdf)

SUBMITTING WATER QUALITY INFORMATION

The Water Quality Planning and Management regulations (40 CFR 130.7) require that "all existing and readily available water quality related data and information" must be evaluated in developing the 303(d) list. A complete list of criteria and information necessary for consideration is found in the CPP.

In general, water quality data must meet the following criteria to be considered:

▲ Ambient data no greater than five years old that indicates attainment status of water quality criteria related to designated uses.

▲ Only data collected before April 30, 2007 should be used in use attainment determinations.

▲ Impairments must be due to specific pollutants that are conducive to the TMDL process, and the specific source causing impairment must be noted in the submittal, if known.

All nominations must include the following information:

✓ **Waterbody Identification**
 Oklahoma currently uses a 14-digit waterbody identification ("WBID#") system. If you do not know the appropriate WBID# for your particular segment, you can provide an accurate legal description or latitude/longitude reference for your segment of concern. In addition, please supply the common name for the waterbody as it is

listed on a United States Geological Survey (USGS) topographical map.

✓ **Justification for Listing Decision**

It is imperative that all attainment decisions are based on ample data and documentation to prove that water quality standards are impaired or not. Your submittal should include a summary of the data used to support the decision, the complete data set (or reference to the complete data set if it is contained in a published report), and an analysis showing water quality standards violation or attainment. *Oklahoma's Water Quality Standards, Use Support Assessment Protocols, and the Integrated Water Quality Report Listing Methodology* procedures in the CPP should be consulted and utilized in your justification and analysis.

✓ **QA/QC Procedures Used**

Data submitted should include information on sampling and analyses, including Quality Assurance and Quality Control (QA/QC) procedures used. DEQ will evaluate the QA/QC protocols used in gathering and analyzing the samples to decide if and how that data will be used. To be used, data must use QA/QC methods that are in accordance with "EPA Requirements for QA Project Plans" (QA/R5, May 2001).

Groundwater Quality

Overview

Groundwater is an important natural resource in Oklahoma. There are twenty-one major groundwater basins in the state and approximately 150 minor basins. These major basins are used as primary source of community drinking water and are estimated to hold over 320 million acre-feet of fresh water. See Figure 8 for a detailed map of the "Major Groundwater Aquifers in Oklahoma".

The Oklahoma CAFO Act puts measures into place that prohibit a hydrologic connection between generated wastewater and waters of the state. The Act further states that samples of water from Licensed Managed Feeding Operations (LMFO) monitoring wells located around swine lagoons shall be collected by the ODAFF and tested at least annually. Licensed Managed Feeding Operations (LMFO's) licensed on or after August 1, 1998 had to install a monitoring "system" (leak detection or wells) before using the retention structure to store liquid wastes. The main goal of the monitoring program is to ascertain if groundwater resources at or near the LMFO's are being subject to any degradation as result of the operation of the facilities and storage of the liquid animal waste. The baseline data for the facilities serves as a reference point to potential change in groundwater quality over time. Beginning in the Fall of 1999 to present date, the Department has been involved with the annual sampling and evaluation of over 1,000 monitoring wells at swine LMFOs as required by provisions in the Act.

There are extensive produced water/brine groundwater plumes in some old oilfield areas due mainly to old spills that were never remediated, leaking unplugged wells, and to the former practice (now banned for over thirty five years) of dumping produced brines into "evaporation pits". Pollutants and saline water have migrated from these surface and subsurface sources into underlying soils and groundwater. Drinking water wells in the some areas have been rendered un-usable, and many streams are now being impacted by saline groundwater plumes that emanate from the old produced water and "evaporation pit" areas. Counties where this has been identified as a known or likely problem include Pottawatomie, Seminole, Kay, Oklahoma, Carter, Garvin, Garfield, and Stephens. Other areas have yet to be investigated.

Since 1996 the Corporation Commission has collected approximately 2500 groundwater samples near known and suspected oil and gas spill sites and/or in response to complaints from citizens in oil and gas field areas. These are taken in domestic water wells; in monitoring wells installed to investigate possible groundwater pollution; from water seeping into borings and dug trenches; and from springs and seeps where groundwater emerges at the surface. Samples are analyzed for TDS, chlorides, and sulfates , petroleum, metals, or other parameters as appropriate, in order to determine what actions are needed in each case. Corp Comm has also begun to list significantly impacted groundwater pollution sites in the OWRB's Appendix H, where the public and water well drillers can be apprised of areas where standard water well installation is inappropriate.

Corp Comm is also attempting to utilize this data in conjunction with surface water data to determine potential sources of watershed impairments and/or areas in which corrective action should be taken. For example, many of the salinity impacted streams found to date have no apparent surface source. However, ground water and spring/seep samples taken near some of these streams show that there is an adjacent subsurface brine plume, probably the source for the stream's excess salinity. If the source for each brine plume could be determined and remediated, the plume(s) could no longer carry pollutants to the streams and cause stream impairments. Corp Comm is using its current ground water sampling data for this purpose in a few areas, but does not yet have the funding to undertake extensive sampling near impaired streams to determine the potential groundwater sources for all impaired streams. Corp Comm is also beginning to obtain GPS locations on all oil and gas wells in the state in order to be able to accurately map well distribution and predict possible impacts.

In addition to groundwater sampling, Corp Comm funded a USGS test of a Helicopter borne Electro-Mag (HEM) tool in 25 (twenty-five) square miles in Carter and Stephens counties near salinity impaired streams. HEM can rapidly cover large areas to determine groundwater impairments and surface water/groundwater interaction. Saline polluted groundwater plumes in aquifers, some of which are flowing into and impairing streams in the study area, are now being mapped. Source location is the next step. In addition, Corp Comm is also trying to obtain grant funding to extend this HEM project to the other thousands of square miles of old oilfield areas in the state, in order to determine which if any also have impacted groundwater.

In 1984, the OWRB established a monitoring network to determine the ambient quality of major aquifers for the development of numeric groundwater quality standards. Between 1984 and 1992, the OWRB collected annual samples from a network of more than 200 domestic, irrigation, stock, and municipal water wells. Samples were analyzed for major ions and metals. Unfortunately, this program was discontinued after nine years of data collection due to lack of funding. However, the OWRB continues to conduct sampling of major aquifers as part of their basin studies and Beneficial Use Monitoring Program (BUMP). For example, in 2001 the OWRB sampled 61 wells in the Cimarron Alluvium and Terrace aquifer for nutrients and major ions. In 2002, 64 wells in the North Fork of the Red River Alluvium and Terrace aquifer were sampled for major ions.

The OWRB has also conducted statewide monitoring of groundwater *quantity* since 1937 through the mass measurement program, in which water levels in more than 585 wells are measured annually to assess long-term trends in groundwater levels and aquifer storage.

OWRB contracts with Oklahoma Department of Agriculture (with the assistance of an EPA grant) to perform compliance groundwater monitoring at swine Licensed Managed Feeding Operations and the number of observation wells in the annual water level measurement program is approximately 500 beginning 2008.

The DEQ has two monitoring programs that address groundwater: the Public Water Supply Compliance Sampling and a 106 Ambient Groundwater Monitoring program. Public water supplies must collect samples at various intervals and locations to determine if the water they serve the public complies with primary drinking water standards as set forth in the Safe Drinking Water Act. Most of these samples are collected at points of entry into the distribution system. The water entering the system at the points of entry can represent one or several groundwater sources. This data is compiled and used to determine areas of contamination and to set expected concentration ranges of various chemical contaminants. Historic data has been compiled going back to the 1920's and future data can be compared to historic ranges to determine changes over time. Intentions are to identify potential concerns before they become major problems.

The DEQ's 106 Groundwater Monitoring Program will use public water supply operators to collect samples from 420 randomly selected PWS wells annually. Samples will be analyzed for secondary drinking water parameters and major ions. Data will be used to evaluate and classify groundwater quality and determine aquifer homogeneity. The three years of monitoring data, analyzed, verified, and compiled are available to State agencies, federal agencies, and the citizens of Oklahoma for their use. This information will be available on the Oklahoma Department of Environmental Quality's website at <http://www.deq.state.ok.us/WQDnew/groundwater/index.html>. Maps of water quality are included here for nitrates, sulfates, and total dissolved solids in the major aquifers. Trends established by this ambient monitoring program can be used to identify sources of polluted runoff that potentially could adversely impact vulnerable groundwater resources.

The DEQ has several remediation programs that identify, monitor, and when needed, remediate local sources of ground water pollution from releases at regulated facilities, historical releases, and spills. Most of these sources are very localized and are not included as areas with problems or concerns.

Major Aquifers with Anthropogenic Water Quality Problems or Concerns

Major aquifers are defined as aquifers which can effectively yield 150 gallons per minute or greater. The following information is based on samples submitted to The DEQ of domestic wells and through the PWS program. This information is based upon the most recent information provided to this division as of December of 2002. For location of the major groundwater aquifers of Oklahoma, please refer to Figure 7.

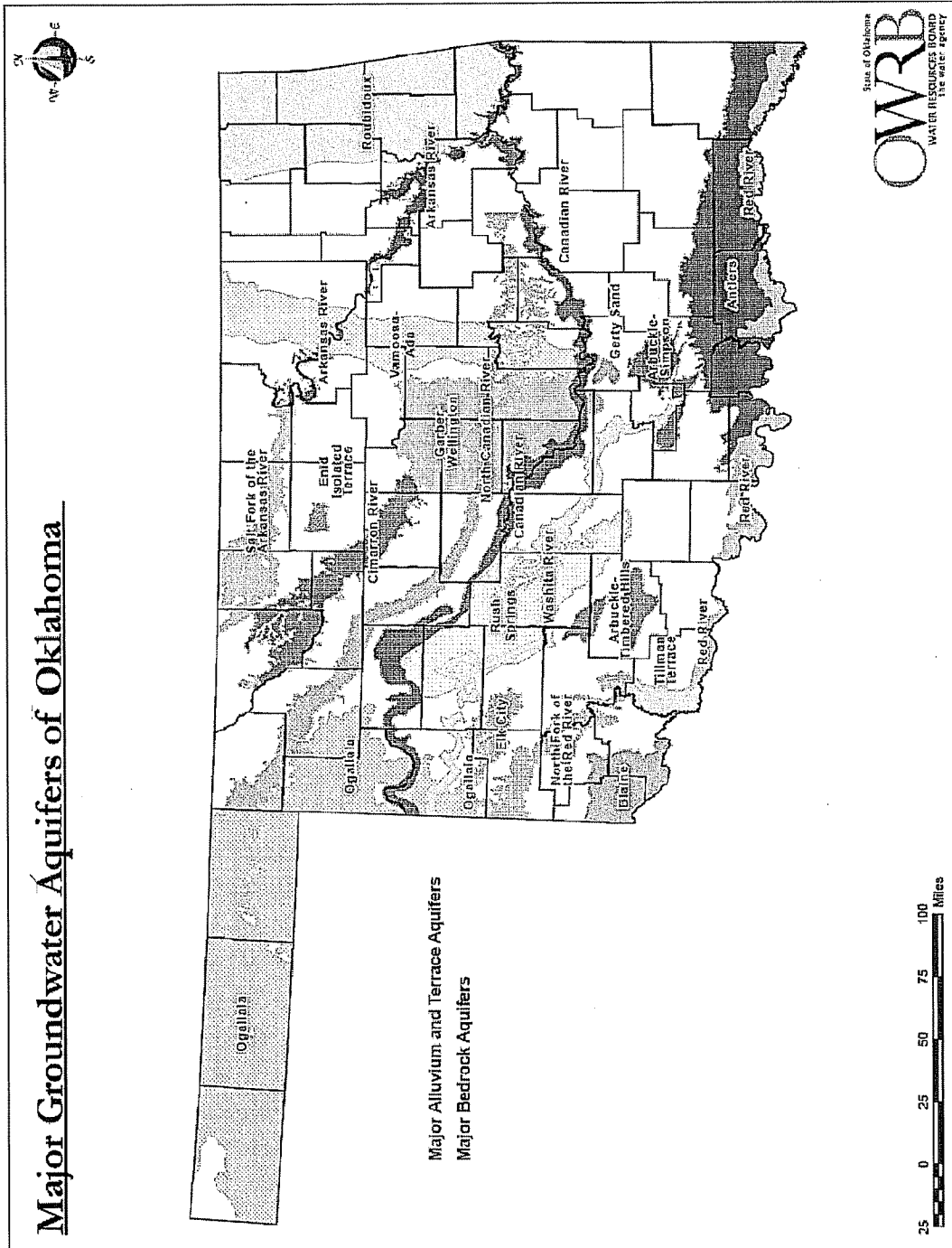
Alluvium and Terrace Deposits of the Salt Fork of the Arkansas River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Arkansas River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

FIGURE 8. GROUNDWATER AQUIFERS OF OKLAHOMA



Alluvium and Terrace Deposits of the Enid Isolated Terrace Deposits

The DEQ has identified a well in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Cimarron River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Beaver-North Canadian River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Canadian River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Washita River

The DEQ has identified a well field in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the North Fork of the Red River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Alluvium and Terrace Deposits of the Red River

The DEQ has identified several wells and well fields in this aquifer with elevated nitrate levels.

Ogallala Formation

The DEQ has identified a well field in this aquifer with elevated nitrate levels. Some of the wells showed elevated levels of selenium, probably of natural origin.

Antlers Sandstone

The DEQ has identified several monitoring wells in this aquifer with elevated nitrate levels. Some of the wells showed consistently low pH values.

Rush Springs Sandstone

The DEQ has identified several wells, monitoring wells and well fields in this aquifer with elevated nitrate levels and a well field with hydrocarbon and chloride contaminations. The contamination is the result of historic oil and gas activities (extraction, refinement, and salt-water disposal).

Garber Sandstone and Wellington Formation

The DEQ has identified several wells in this aquifer with gross alpha activity above the maximum allowable limit of 15 pCi/L. The Department has also identified several wells and well fields with selenium contamination. Localized wells and monitoring wells have been identified with industrial solvent contamination. Several wells have been detected with elevated levels of nitrates and chlorides. Arsenic is naturally occurring within this aquifer and several excursions above the new MCL of 10 g/L have been noted via DEQ source monitoring actions.

Roubidoux Formation

The DEQ has identified several newly installed wells in this aquifer that show local elevated iron, sulfate, and total dissolved solid levels in Ottawa County attributed to mine water contamination from historical mining from the Tar Creek Superfund site. The intervening Boone Formation is heavily impacted by the mining and is the source for localized problems within the Roubidoux. DEQ and EPA continue to monitor water quality in this area under the After Action Monitoring Program.

Vamoosa Formation

The DEQ has identified several wells in this aquifer with elevated fluoride levels. The DEQ, the OWRB, and the United States Geological Survey have identified several wells and well fields with chloride contamination.

The Arbuckle Formation

The DEQ has identified several monitoring wells in this aquifer with elevated fluoride levels and a tendency towards excessive hardness. There are no known groundwater based community public drinking water systems experiencing water quality problems. The source appears to be natural and has therefore limited the usefulness of this formation as a drinking water source.

Non-major Aquifers with Anthropogenic Water Quality Problems or Concerns

Non-major aquifers are defined as aquifers which effectively yield less than 150 gallons per minute. The following information is based primarily on individual wells or well fields that were affected by problems. These wells may or may not constitute a public water supply. In most cases, the problem wells are not in use, or have had their water blended with other sources to reduce the contaminant(s) to acceptable level(s). For location of the major aquifers, please refer to the maps "Alluvium and Terrace Deposits in Oklahoma" and "Major Bedrock Aquifers in Oklahoma".

The Boone Formation/Boone Chert/Keokuk and Reeds Springs Formation

The DEQ and the OWRB have identified several monitoring wells in this aquifer at the Tar Creek Superfund site in Ottawa County with low pH levels and heavy metal contamination. The source of contamination is from historic mining operations. This formation overlays the Roubidoux Formation. The Roubidoux Formation is threatened and locally impacted near several monitoring wells due to the severity of the contamination in the overlaying formations.

The Oscar "A" Formation

The DEQ has identified several wells in this aquifer with elevated nitrate levels and gross alpha activity above the maximum allowable limit of 15 pCi/L. These concerns are similar to those expressed for the Garber/Wellington Formation.

McAlester and Hartshorne Formation-Savanna Formation/McAlester Formation/Hartshorne Sandstone Formation

The DEQ has identified several monitoring wells in this aquifer with low pH levels, heavy metal contamination, chlorides, and some controlled industrial wastes. The source of contamination is from historic mining operations and off-site disposal pits for oil field and industrial waste.

Walnut Creek Alluvium Deposits

The DEQ has identified two well fields in this aquifer with elevated nitrate levels.

Tillman Terrace Deposits

The DEQ has identified two well fields in this aquifer with elevated nitrate levels and elevated levels of selenium.

Little Sandy Creek Alluvium Deposits

The DEQ has identified a well field in this aquifer with elevated nitrate levels.

West Cache Creek Terrace

The DEQ has identified a well field in this aquifer with elevated nitrate levels.

Major Sources of Contamination

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The major sources of contamination within the state are listed in Table 19. The basis used for establishing the priority ranking system was based upon information collected from the various monitoring programs (e.g. the monitoring network, the ambient monitoring program and the wellhead protection program and the Tar Creek After-Action Monitoring Program).

TABLE 19. MAJOR SOURCES OF CONTAMINATION

Contaminant Sources	Highest Priority Sources	Factors Considered in Selecting a Contaminant Source ¹	Contaminants ²
Agricultural Activities			
Agricultural Chemical Facilities			
Animal Feedlots	√	A - C - D - E	E - J
Drainage Wells			
Fertilizer Applications	√	C - E	E
Irrigation Practices	√	C - E	E
Pesticide Applications			
Storage and Treatment Activities			
Land Application	√	C - D - E	D - E - H - J - L
Material Stockpiles			
Storage Tanks (Above Ground)			
Storage Tanks (Underground)	√	A - C - E	D
Surface Impoundments	√	A - C - D - E	D - E - G - H - J - L
Waste Piles	√	C - D	H
Waste Tailings	√	C - D	H
Disposal Activities			
Deep Injection Wells	√	C - D - E	C - D - G - H
Landfills			
Septic Systems	√	A - C - D - E	E - J - L
Shallow Injection Wells			
Other			
Hazardous Waste Generators			
Hazardous Waste Sites			
Industrial Facilities			
Material Transfer Operations			
Mining and Mine Drainage	√	A - C - D - E	H
Pipelines and Sewer Lines			
Salt Storage and Road Salting			
Salt Water Intrusion	√	C - D - E	G - D
Spills		D	D - G
Transportation of Materials		D	D
Urban Runoff			
Other Sources	√	A - C - D - E	A - B - D - E - G - J - L - M
Abandon Wells (Unplugged)			

KEY TO TABLE 18

<u>1</u>	<u>2</u>
A. Human health and/or environmental risk (toxicity)	A. Inorganic Pesticides
B. Size of the population at risk	B. Organic Pesticides
C. Location of the sources relative to drinking water sources	C. Halogenated Solvents
D. Number and/or size of contaminant sources	D. Petroleum Compounds
E. Hydrogeologic sensitivity	E. Nitrate
F. State findings, other findings	F. Fluoride
G. Other	G. Salinity/Brine
	H. Metals
	I. Radionuclides
	J. Bacteria
	K. Protozoa
	L. Viruses
	M. Any Unlisted Surface Contaminants

Overview of State Groundwater Protection Programs

Table 20 contains a summary of the state groundwater protection programs.

The DEQ received authority under HB 2227 and 1002 and S. B. 361 (clean up bill for HB 1002) to be the lead agency for Oklahoma's Wellhead Protection Program. Due to the variety of potential causes and sources of groundwater contamination, other state environmental agencies are involved in this program. These include the ODAFF, OWRB, OCC, Corporation Commission, Wildlife Department, and the Department of Mines.

TABLE 20. SUMMARY OF THE STATE GROUNDWATER PROTECTION PROGRAMS

Program or Activities	Check if active	Implementation Status	Responsible Agency
Active SARA Title III Program	√	FE	DEQ
Ambient groundwater monitoring system	√	CE	DEQ
Aquifer vulnerability assessment	√	FE	DEQ*
Aquifer mapping	√	CE	OWRB*
Aquifer characterization	√	CE	OWRB*
Comprehensive data management system	√	CE	DEQ
EPA - endorsed Core Comprehensive State Groundwater Protection Program (CSGWPP)	√	CE	DEQ*
Groundwater discharge permits	√	FE	DEQ*
Groundwater Best Management Practices	√	CE - UR	DEQ*
Groundwater legislation	√	CE	OWRB*
Groundwater classification	√	CE	OWRB*
Groundwater quality standards	√	CE	OWRB*
Interagency coordination for groundwater protection initiatives	√	CE	OSE*
Nonpoint source controls	√	UD	OCC*
Pesticides State Management Plan	√	FE	ODAFF
Pollution Prevention Program	√	FE	DEQ

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Program or Activities	Check if active	Implementation Status	Responsible Agency
Resource Conservation and Recovery Act (RCRA) Primacy	√	FE	DEQ
Source Water Assessment and Protection Program (SWAP)	√	FE	DEQ
State Superfund	√	CE	DEQ
State RCRA Program incorporating more stringent requirements than RCRA Primacy	√	CE	DEQ
State septic system regulations	√	FE	DEQ
Underground storage tank installation requirements	√	FE	Corp. Comm
Underground Storage Tank Remediation Fund	√	FE	Corp. Comm
Underground Storage Tank Permit Program	√	FE	Corp. Comm
Oil & Gas well drilling, commercial mud pit, and land application permit programs	√	FE	Corp. Comm.
<u>Special protective rules for pit liners and O&G well casing when close to water wells</u>	√	FE	Corp. Comm.
Oil & Gas injection well UIC Program	√	FE	Corp. Comm.
Oil & Gas state abandoned well plugging fund program	√	FE	Corp. Comm.
Oil & Gas surface and groundwater assessment and remediation oversight programs	√	FE	Corp. Comm.
Oil & Gas orphaned and abandoned well site cleanup program (state authorized industry funded)	√	FE	OERB
Oil & Gas base of fresh/treatable water mapping program	√	CE	Corp. Comm.
Underground Injection Control Program	√	FE	DEQ*
Vulnerability assessment for drinking water / wellhead protection	√	CE	DEQ
Well abandonment regulations	√	FE	OWRB*
Wellhead Protection Program (EPA - approved)	√	CE - FE	DEQ
Well installation regulations	√	FE	OWRB*

KEY TO TABLE 19

Implementation Status		Responsible Agency	
CE	Continuing Efforts	DEQ	Oklahoma Dept. of Environmental Quality
FE	Fully Established	OCC	Oklahoma Conservation Commission
NA	Not Applicable	Corp Comm	Oklahoma Corporation Commission
P	Pending	OWRB	Oklahoma Water Resources Board
UD	Under Development	OSE	Office of the Secretary of Environment
UR	Under Revision	OERB	Oklahoma Energy Resources Board
		ODAFF	Oklahoma Dept. of Agriculture Food and Forestry

Oklahoma's Wellhead Protection Program

The DEQ developed its Wellhead Protection Program in accordance with the EPA guidelines set forth under the Safe Drinking Water Act ' 1428 (as amended in 1986). Oklahoma's Wellhead Protection Program is a mechanism to assist local communities in protecting their groundwater based drinking supplies. The goal of the Wellhead Protection Program is to delineate protected areas around a drinking water wellhead. In these protected areas, potential causes and sources of groundwater contamination can be identified and managed thus reducing or eliminating the risk of well contamination.

Under Oklahoma's Wellhead Protection Program, managers of groundwater based drinking water systems may contact the DEQ to request technical assistance. The state will also offer technical assistance for such tasks as evaluating the potential for groundwater contamination, determining possible sources of contamination, proposing model ordinances for control of potential sources of contamination, and/or preparing a contingency plan in the event of well contamination. The program advocates land use restrictions around the wellhead. At present, emphasis is placed on the development of contingency plans, educational programs and voluntary implementation of best management practices to reduce or eliminate the need for restrictive regulatory protection.

Groundwater Indicators

The DEQ routinely monitors public drinking water wells for nitrates, coliform bacteria, volatile organic compounds and other drinking water quality parameters. The DEQ has regulatory authority for public water supplies under 63 O.S. 1981, ' 1-901 *et seq.* The regulations were last amended by the Oklahoma State Board of Health on February 8, 1990 (effective May 25, 1990) and incorporated into the DEQ on January 1, 1993 (effective July 1, 1993 and amended July 1, 2003). Table 20 lists the various supply systems with standards violations. With the exception of nitrate as nitrogen, most of the contaminants are of natural origin. Note that in the "Date Violation Confirmed" column, some violations are of recent discovery and others have been known for several years.

TABLE 21. PUBLIC WATER SUPPLY STANDARDS VIOLATIONS

System Name	County	Aquifer	Date Violation Confirmed	Current Level (mg/L)	Date of Last Analysis
Nitrate, Maximum Allowable Limit – 10 mg/L (ppm)					
Aline	Alfalfa	Cimarron Terrace	2000	13	11/2/2007
Canadian Co RWD # 1	Canadian	North Canadian River Alluvium	1994	14	9/25/2007
Carmen	Alfalfa	Cimarron Terrace	1995	11	10/15/2007
Cimarron City	Logan	Cimarron Alluvium	2005	11	12/6/2006
Cleo Springs	Major	Cimarron Terrace	1993	11	4/16/2007
Deer Creek	Grant	Arkansas River, Salt Fork Alluvium	1993	11	9/14/2007
Garfield Co RWD # 5	Garfield	Cimarron Terrace - Cedar HL	1994	14	8/2/2007
Garfield Co RWD #1 (KREM-HILL)	Garfield	Enid Terrace	1993	11	6/6/2006
Goltry	Alfalfa	Turkey Creek Alluvium	1993	15	10/28/2007
Hollis	Harmon	Red River, Salt Fork Terrace	1993	12	9/14/2007
Hydro PWA	Caddo	Rush Springs Sandstone	1995	12	6/6/2006
Laverne	Harper	North Canadian River Terrace	2005	11	9/14/2007
Logan Co RWD #2	Logan	Cimarron River Terrace	1993	15	10/2/2007
Loyal	Kingfisher	North Canadian River Alluvium	1998	12	6/4/2007
Major Co RWD #1	Major	Cimarron Terrace	1996	11	4/18/2007

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System Name	County	Aquifer	Date Violation Confirmed	Current Level (mg/L)	Date of Last Analysis
Mooreland	Woodward	North Canadian River Terrace	1993	11	10/16/2007
North Blaine Water	Blaine	North Canadian River Alluvium	1993	14	7/11/2007
North Blaine Water	Blaine	Cimarron River Terrace	1993	14	7/11/2007
Okarche	Kingfisher	North Canadian River Alluvium	2001	12	9/14/2007
Okarche RWD	Kingfisher	North Canadian River Alluvium	1988	14	11/2/2007
Payne Co RWD #3	Payne	Stillwater Creek Alluvium	1990	13	11/2/2007
Payne Co RWD #3	Payne	Vamoosa	1990	13	11/2/2007
Raintree Addition	Osage	Arkansas River Alluvium	2000	12	10/15/2007
Southern Hills Inc	Stephens	Unknown	2007	20.5	9/14/2007
Thirsty Water Corp.	Greer	Red River, North Fork Terrace	2005	11	9/14/2007
Timberline MHP	Osage	Arkansas River Alluvium	1993	23	10/2/2007
Tuttle	Grady	Unknown	2000	12	10/5/2007
Apex Fitness	Grady	Unknown	2006	12	11/2/2006
Big Belly Bar B Que	Cleveland	Unknown	2004	11	6/6/2006
Cummins Pontiac	Custer	Unknown	2005	17	7/23/2007
IBS Pizza and Deli Convenience Store	Logan	Unknown	2005	20	10/2/2007
Mycoland RV & Mobile Home Park	Osage	Arkansas River Alluvium	1993	11	7/21/2006
Syms Stop & Shop	Woodward	Unknown	2007	11	11/2/2007
Arsenic, Maximum Allowable Limit – 0.010 mg/L (ppm)					
Cedar Ridge Estates Development Co	Logan	Unknown	2007	0.027	9/14/2007
Applewood MHP	Oklahoma	Garber-Wellington	1985	0.061	12/18/2007
Edmond PWA – Arcadia	Oklahoma	Garber-Wellington	2007	0.023	11/6/2007
Corn PWA	Washita	Rush Springs Sandstone	2007	0.008	1/6/2006
Cadmium, Maximum Allowable Limit – 0.005 mg/L (ppm)					
Falconhead Property Owners Association	Love	Antlers Sand	2006	0.008	1/6/2006
Fluoride, Maximum Allowable Limit – 4.0 mg/L (ppm)					
Three Springs Farm	Cherokee	Unknown	2005	5.2	5/18/2006
Tetrachloroethylene, Maximum Allowable Limit – 0.005 mg/L (ppm)					
Highpoint MHP	Garfield	Enid Terrace	2006	0.013	11/28/2006

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References

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Appendix A

Oklahoma Waterbody Identification (WBID) System

Waterbody identification (WBID) numbers are established based on a waterbody's location in the State's Water Quality Management Plan. WBIDs are unique identifiers that offer a convenient, unambiguous method of referencing waterbodies within the State of Oklahoma. A complete WBID consists of a two-letter, fourteen-digit identifier.

Example: **OK311500030010_00** - Elk Creek in southwest Oklahoma

The first two characters define the state code as required by EPA.

"OK

The next six digits are derived from Oklahoma's Water Quality Management Planning Basins. The State's seven large, one-digit planning basins are broken down into smaller basins, each identified with a six-digit number.

"OK 311500"

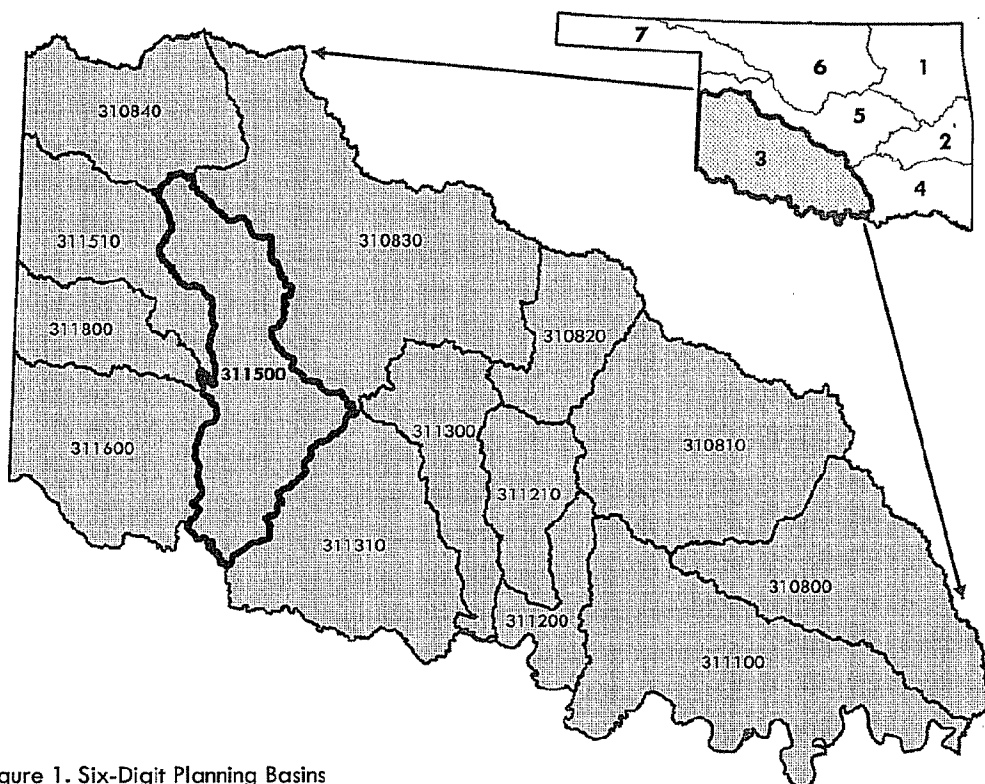


Figure 1. Six-Digit Planning Basins

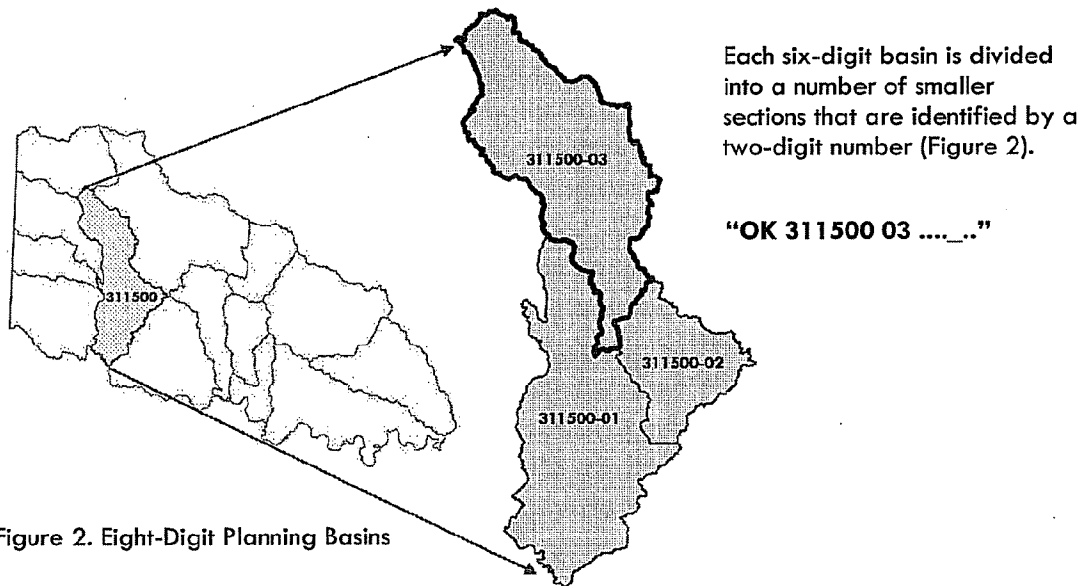
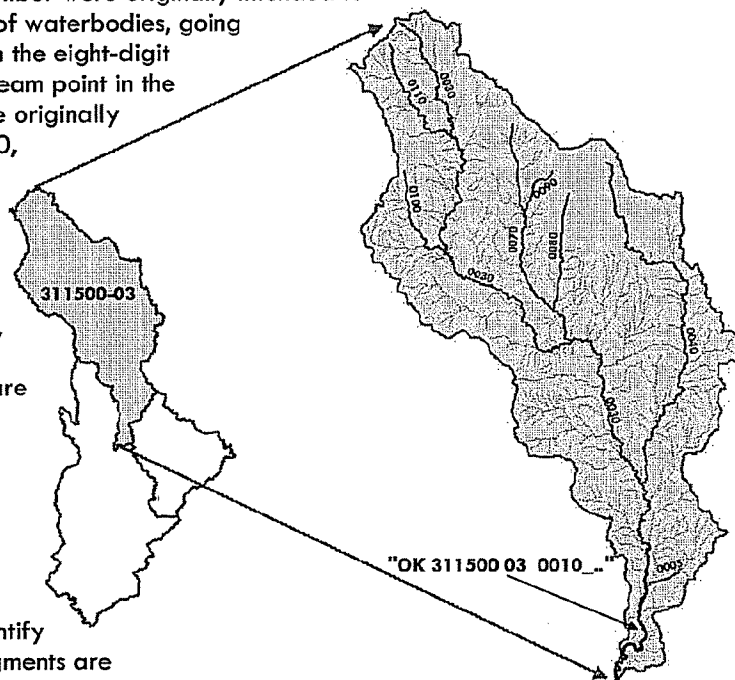


Figure 2. Eight-Digit Planning Basins

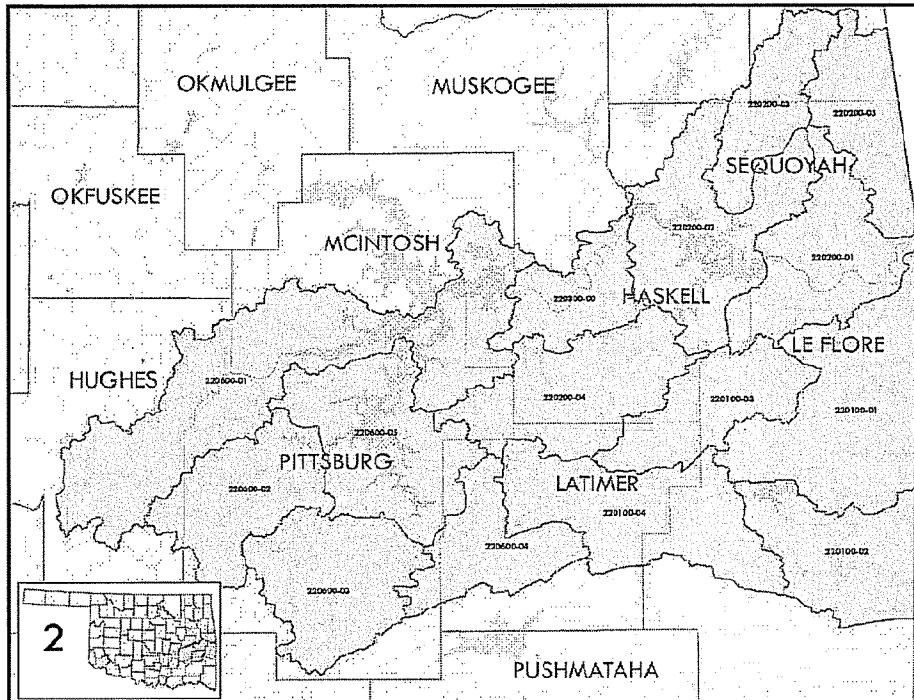
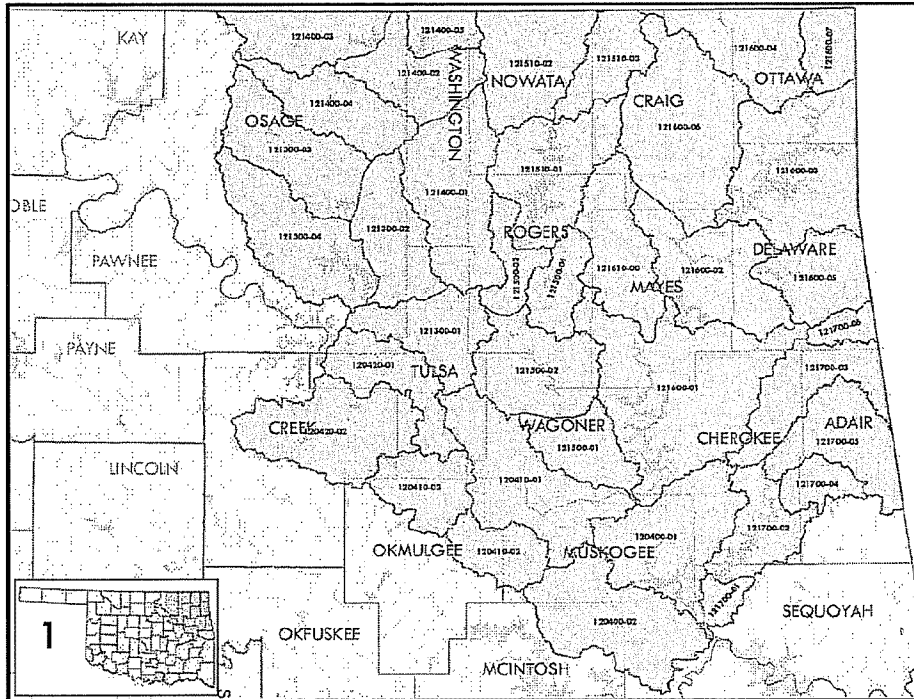
The next four digits of a WBID number were originally intended to represent a hydrologic sequence of waterbodies, going from the most downstream point in the eight-digit watershed up to the furthest upstream point in the watershed. These four digits were originally selected by tens (e.g., 0010, 0020, 0030). This provided for the addition of waterbodies while maintaining the hydrologic sequence as much as possible. Not all waterbodies have been assigned an identification number, primarily due to limited resources and need. As more waterbodies are assessed, the WBID system is designed to incorporate a unique identifier for these waterbodies (Figure 3).

The last two digits of a WBID number allow a waterbody to be segmented further in order to identify specific portions. Waterbody segments are identified by a segment ID made up of an underscore and two additional digits. Waterbodies are initially assigned a segment ID of _00. If additional segmentation is required, upstream segments receive a number higher in value (e.g., _10, _20, _30).

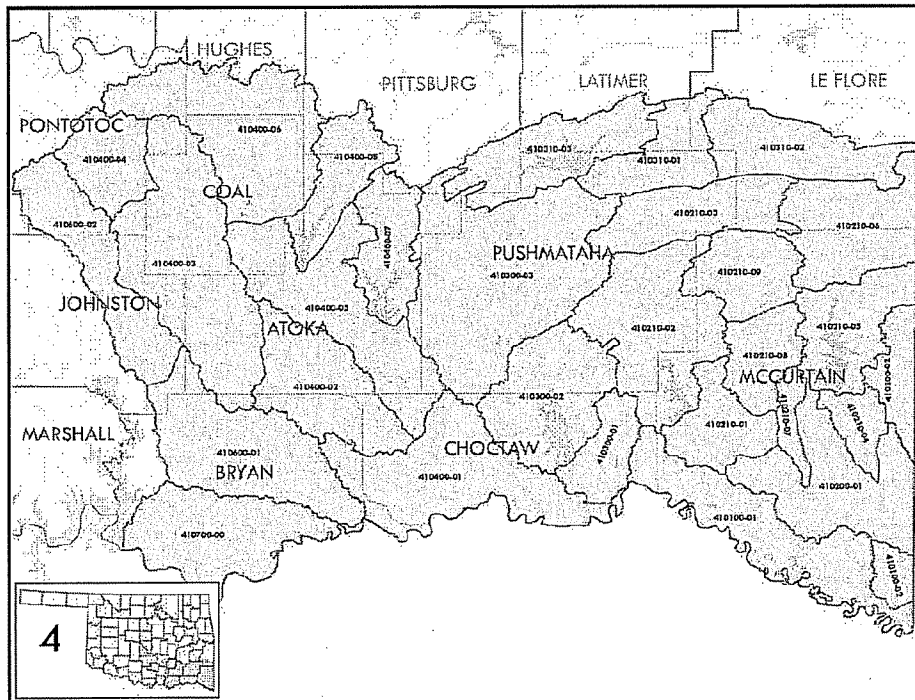
Figure 3. WBID Numbers



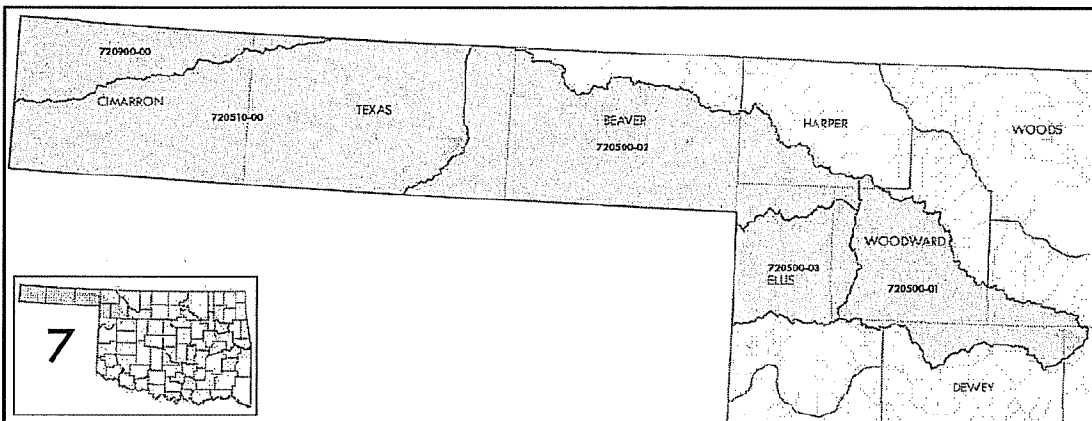
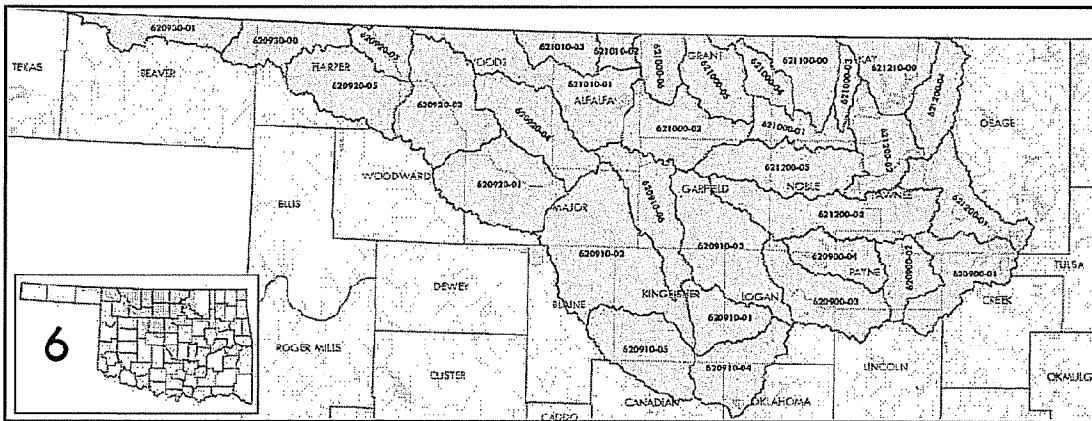
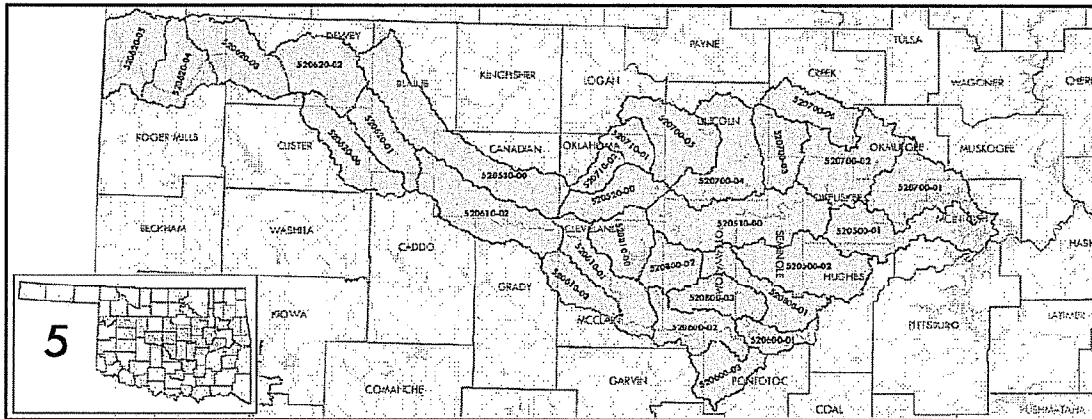
Elk Creek
"OK 311500 03 0010_00"



Oklahoma 8-digit Planning Basins 1 and 2



Oklahoma 8-digit Planning Basins 3 and 4



Oklahoma 8-digit Planning Basins 5, 6, and 7

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Appendix C

2008 Oklahoma 303(d) List of Impaired Waters

<u>Waterbody ID</u>	<u>Waterbody Name</u>	<u>Waterbody Size</u>	<u>Category</u>	<u>TMDL Date</u>	
OK120400010070_00*	Webbers Falls Lake	11,600.00 ACRES	5a	2016	NEW
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>			
<i>Enterococcus*</i>	<i>Primary Body Contact Recreation</i>	<i>46, 108, 136, 140</i>			
OK120400010130_00	Greenleaf Lake	920.00 ACRES	5a	2013	
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>			
<i>Chlorophyll-a*</i>	<i>Public and Private Water Supply</i>	<i>140</i>			
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	140			
Turbidity	FWP - Warm Water Aquatic Community	140			
OK120400010260_00	Arkansas River	11.17 MILES	5a	2013	
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>			
Cadmium	FWP - Warm Water Aquatic Community	34, 62, 85, 140			
<i>Chloride*</i>	<i>Agriculture</i>	<i>49, 102, 140</i>			
Enterococcus	Primary Body Contact Recreation	34, 108, 133, 136, 140			
Lead	FWP - Warm Water Aquatic Community	34, 62, 85, 140			
Lead	Fish Consumption	34, 62, 85, 140			
<i>Total Dissolved Solids*</i>	<i>Agriculture</i>	<i>49, 102, 140</i>			
OK120400010400_00	Coody Creek	16.16 MILES	5a	2013	
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>			
<i>Enterococcus*</i>	<i>Primary Body Contact Recreation</i>	<i>46, 59, 92, 108, 111, 133, 136, 140</i>			
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 59, 87, 92, 108, 111, 133, 136, 140			
OK120400020010_00	Dirty Creek	44.18 MILES	5a	2016	
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>			
Turbidity	FWP - Warm Water Aquatic Community	21, 46, 49, 87, 108, 140			
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 87, 92, 108, 136, 140			
OK120400020030_00	Dirty Creek, South Fork	15.55 MILES	5a	2019	
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>			
<i>Enterococcus*</i>	<i>Primary Body Contact Recreation</i>	<i>4, 46, 59, 92, 108, 111, 133, 136, 140</i>			
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 85, 87, 92, 108, 111, 133, 136, 140			
OK120400020110_00	Dirty Creek, Georges Fork	10.05 MILES	5a	2016	
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>			
<i>Enterococcus*</i>	<i>Primary Body Contact Recreation</i>	<i>46, 92, 108, 111, 133, 136, 140</i>			
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 87, 92, 108, 111, 133, 136, 140			
OK120400020160_00	Butler Creek	10.34 MILES	5a	2019	
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>			
<i>Enterococcus*</i>	<i>Primary Body Contact Recreation</i>	<i>46, 59, 92, 108, 111, 133, 136, 140</i>			
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 59, 87, 92, 108, 111, 133, 136, 140			


Cause Name* - Indicates new cause listing for 2008

Waterbody ID* & **NEW** - Indicate new waterbody listing for 2008

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<u>Waterbody ID</u>	<u>Waterbody Name</u>	<u>Waterbody Size</u>	<u>Category</u>	<u>TMDL Date</u>
OK121600070010_00	Spring River	22.11 MILES	5a	2016
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Zinc	FWP - Cool Water Aquatic Community	82, 140		
Turbidity	FWP - Cool Water Aquatic Community	46, 108, 140		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 108, 133, 136, 140		
Lead*	Fish Consumption	49, 85, 140		
Lead*	FWP - Cool Water Aquatic Community	49, 85, 140		
OK121610000050_10	Pryor Creek	4.97 MILES	5a	2016
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Enterococcus	Primary Body Contact Recreation	46, 68, 85, 92, 108, 111, 128, 133, 136, 140		
Escherichia coli*	Primary Body Contact Recreation	46, 68, 92, 108, 111, 128, 133, 136, 140		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	46, 85, 87, 92, 108, 111, 128, 133, 136, 140		
Total Dissolved Solids*	Agriculture	49, 102, 140		
OK121610000090_00	Pryor Creek	2.35 MILES	5a	2019
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Turbidity	FWP - Warm Water Aquatic Community	156, 140		
Escherichia coli	Primary Body Contact Recreation	84, 85, 92, 156, 140		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	84, 85, 92, 156, 140		
OK121700020020_00	Tenkiller Ferry Lake	8,440.00 ACRES	5a	2010
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Phosphorus (Total)	Aesthetic	140		
Chlorophyll-a*	Public and Private Water Supply	4, 59, 108, 136, 146, 140		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	140		
OK121700020110_00	Chicken Creek	3.54 MILES	5a	2010
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Fishes Bioassessments	FWP - Warm Water Aquatic Community	140		
OK121700020220_00	Tenkiller Ferry Lake, Illinois River Arm	5,030.00 ACRES	5a	2010
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Oxygen, Dissolved	FWP - Warm Water Aquatic Community	4, 46, 59, 92, 108, 136, 146, 140		
OK121700030010_00	Illinois River	7.68 MILES	5a	2010
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Enterococcus	Primary Body Contact Recreation	4, 59, 85, 108, 136, 146, 140		
Phosphorus (Total)	Aesthetic	4, 46, 59, 85, 92, 100, 108, 146, 140		
OK121700030040_00	Tahlequah Creek (Town Branch)	6.21 MILES	5a	2010
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Escherichia coli	Primary Body Contact Recreation	46, 92, 108, 133, 136, 140		

Cause Name* - Indicates new cause listing for 2008

Waterbody ID* &  - Indicate new waterbody listing for 2008

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<u>Waterbody ID</u>	<u>Waterbody Name</u>	<u>Waterbody Size</u>	<u>Category</u>	<u>TMDL Date</u>
OK121700030080_00	Illinois River	31.68 MILES	5a	2010
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Phosphorus (Total)	Aesthetic	4, 46, 59, 108, 133, 136, 146, 140		
Lead*	FWP - Cool Water Aquatic Community	140		
Escherichia coli	Primary Body Contact Recreation	4, 46, 59, 92, 108, 133, 136, 146, 140		
Fecal Coliform	Primary Body Contact Recreation	4, 46, 59, 92, 108, 133, 136, 146, 140		
OK121700030280_00	Illinois River	15.65 MILES	5a	2010
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Phosphorus (Total)	Aesthetic	4, 46, 59, 92, 108, 133, 136, 146, 140		
OK121700030290_00	Flint Creek	1.60 MILES	5a	2010
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Oxygen, Dissolved	FWP - Cool Water Aquatic Community	4, 46, 59, 92, 108, 133, 136, 146, 140		
Phosphorus (Total)*	Aesthetic	4, 46, 59, 92, 108, 133, 136, 146, 140		
OK121700030350_00	Illinois River	5.18 MILES	5a	2013
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 100, 108, 133, 136, 146, 140		
Phosphorus (Total)	Aesthetic	4, 34, 46, 59, 92, 100, 133, 136, 146, 140		
Turbidity	FWP - Cool Water Aquatic Community	46, 59, 85, 108, 146, 140		
OK121700030370_00*	Ballard Creek	12.60 MILES	5a	2013
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Enterococcus*	Primary Body Contact Recreation	4, 46, 59, 92, 108, 111, 133, 136, 140		
OK121700040010_00*	Caney Creek	20.92 MILES	5a	2016
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Enterococcus*	Primary Body Contact Recreation	4, 46, 59, 62, 85, 92, 108, 133, 136, 140		
OK121700050010_00	Illinois River, Baron Fork	23.30 MILES	5a	2013
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 108, 133, 136, 146, 140		
Phosphorus (Total)	Aesthetic	4, 46, 59, 92, 108, 133, 136, 146, 140		
OK121700050090_00	Tyner Creek	14.89 MILES	5a	2013
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 108, 136, 140		
OK121700050120_00	Peachater Creek	10.28 MILES	5a	2013
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 100, 108, 128, 136, 140		
OK121700060010_00	Flint Creek	7.75 MILES	5a	2010
<u>Cause of Impairment</u>	<u>Impaired Use</u>	<u>Potential Sources</u>		
Enterococcus	Primary Body Contact Recreation	4, 46, 59, 92, 100, 108, 111, 133, 136, 146, 140		
Phosphorus (Total)	Aesthetic	4, 59, 146, 140		

Cause Name* - Indicates new cause listing for 2008

Waterbody ID* & NEW - Indicate new waterbody listing for 2008